MATRIS

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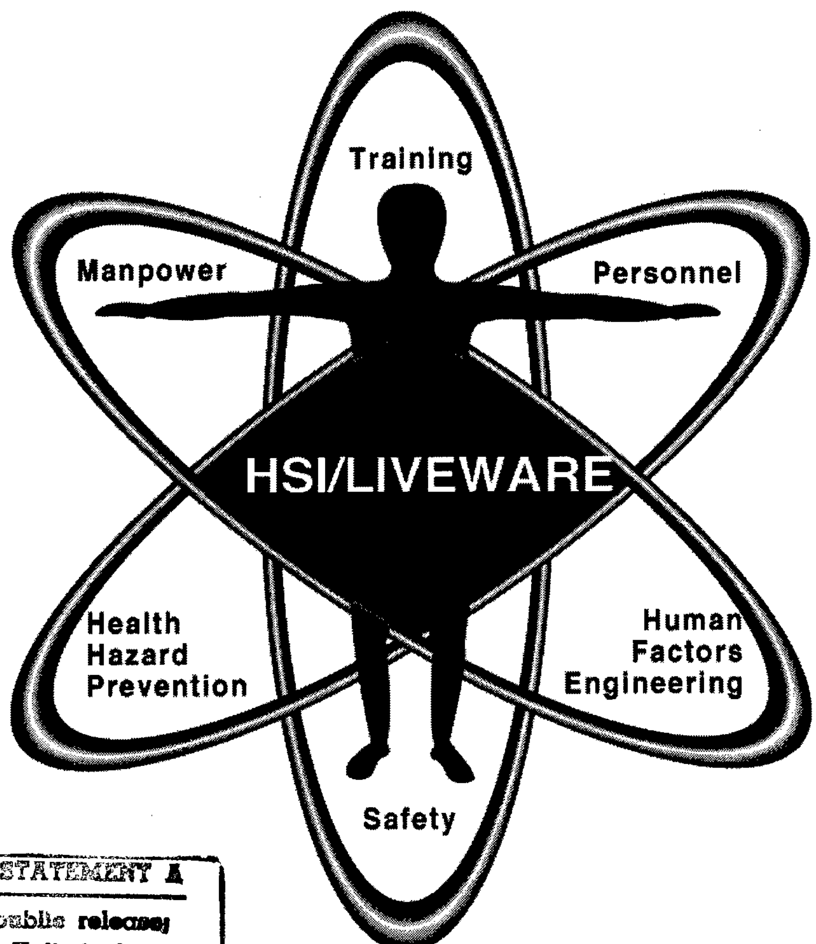
Directory of Design Support Methods



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13. ABSTRACT *(Maximum 200 words)*

This Directory contains records of human factors databases, handbooks, data guides, texts, journals, standardization documents, prototype and interface design tools, analytic techniques, and computer simulation software. The Directory describes the methods to be used and their purposes, products, and availability. It serves as a resource for applying human systems integration principles, to be used by anyone who is designing a system or evaluating a system design.

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DIRECTORY OF DESIGN SUPPORT METHODS

OCTOBER 1998

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PREFACE

This Directory of Design Support Methods (DDSM) is a revision of the original report developed under the auspices of the Designing for the User Subgroup of the Department of Defense Human Factors Engineering Technical Advisory Group (DoD HFE TAG). The original document, and its associated database, have been expanded to include the NATO Panel 8, Research Study Group 21 LIVEWARE database. This document provides an annotated directory of human systems integration (HSI) design support tools and techniques that have been developed by the DoD, NASA, FAA, NATO countries, academia, and private industry.

The DDSM contains references to databases, handbooks, data guides, texts, journals, standardization documents, prototype and interface design tools, analytic techniques, and computer simulation software. The DDSM describes the methods to be used and their purpose, products, and availability. It serves as a resource for applying HSI principles, to be used by anyone who is designing a system or evaluating a system design.

The format for each entry in the DDSM offers the name of the method, the sponsor, a current point of contact, and a full description, including general overview, appropriate uses, input requirements, processing procedures, and output product uses. The format also includes references, alternative approaches, availability status, and information on how to obtain the product.

Each reference in the DDSM represents an individual record, drawn from the HSI/LIVEWARE database maintained at MATRIS. The HSI/LIVEWARE database is a centralized repository, the focus of which is the integration of human-machine and manpower/personnel/training elements into the system design and acquisition process. New records continue to be added as new human factors tools and techniques are developed. The MATRIS Office periodically updates and republishes the DDSM to reflect the record changes and additions. The DDSM contains references to design tools or techniques that are currently available or under development. Records of products or processes that are no longer in use are archived in the HSI/LIVEWARE database, and can be retrieved as part of subject-specific, customized reports generated by the MATRIS Technical Information Specialists.

The most current version of the DDSM, updated continuously on the Internet, may be found at the MATRIS Website: **http:\\dticam.dtic.mil**.

To submit records for inclusion in the HSI/LIVEWARE database and in future editions of the DDSM, please contact the MATRIS Office, or use the HSI/LIVEWARE Submission Form found on the MATRIS Website.

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OVERALL CATEGORY:	Tool
STATUS:	Available

TITLE: 2D Static Strength Prediction Program (TM)

SPONSOR: University of Michigan - Software Technology Management Office
POINT OF CONTACT: Ms Deborah W Alper / 313-936-0435
EMAIL: dalper@umich.edu
RECORD NO.: HSI00099

GENERAL OVERVIEW:
This program is a microcomputer software modeling tool used to predict human static strength requirements of manual material-handling tasks such as lifts, lowers, presses, pushes and pulls. It is the result of 22 years of research at the Univ. of Michigan's highly regarded Center for Ergonomics, and is in use at sites all over the world.

APPROPRIATE USES:
Ergonomic job analysis, design and modification for work involving materials handling. Program is used by ergonomists, engineers, loss control specialists, physical and occupational therapists, physicians, researchers and others who evaluate and design jobs.

EQUIPMENT REQUIRED:
PC with DOS 5.0 or later; 286 RAM minimum.

INPUTS REQUIRED:

I. Anthropometric Data:	gender, height and weight
II. Postural Data:	body link angles for upper arm, lower arm, torso, upper leg, lower leg or use convenient option of selecting from 28 preset postures
III. Force Parameters:	weight and direction of force

OUTPUT:
Predictions of percent of adult population with strength to perform the task described and predictions of back compression force. Comparison with NIOSH guidelines. Predictions are presented in tables and bar charts. Stick-figure illustration with floor coefficient of friction value. Additional tables present joint moments, body link lengths, masses and center-of-gravity locations, abdominal pressure and force predictions, torso muscles force predictions, and batch output of sequential static posture analyses.

USES OF OUTPUT:
To help prevent worker injury, design new jobs, and evaluate changes to existing jobs.

DOCUMENTATION:
Chaffin and Andersson, "Occupational Biomechanics", John Wiley and Sons. Numerous articles in academic and professional journals.

ALTERNATIVE/COMPARABLE APPROACHES:
None known.

STAGE OF DEVELOPMENT:
Currently available. User's manual comes with program disk.

To obtain, contact: University of Michigan Software
Technology Management Office
3003 S. State St.

Wolverine Tower, Rm 2071
Ann Arbor, MI 48109-1280
Phone: 313-936-0435
FAX: 313-936-1330

VALIDATION:
Validation studies have been conducted. Please contact POC for more specific information.

COMMENTS:
None.

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: Air Combat Environment Test and Evaluation Facility (ACETEF)

SPONSOR: Naval Air Warfare Center - Aircraft Div (NAWCAD)
POINT OF CONTACT: Mr R R Smullen / 301-342-6004, DSN: 342-6004
EMAIL: rsmullen@arf.nawcad.navy.mil
RECORD NO.: HSI00005

GENERAL OVERVIEW:
The Air Combat Environment Test and Evaluation Facility (ACETEF) is a premier ground test facility whose primary purpose is to test installed aircraft systems in an integrated multi-spectral warfare environment using state-of-the-art simulation and stimulation technology. Aircraft platforms, typically placed in an anechoic chamber, are deceived through a combination of simulation by digital computer and stimulation by computer-controlled environment generators that provide radio frequency, electro-optical, and laser stimuli that closely duplicate real signals in a combat mission environment. The ACETEF has several laboratories which provide signal generation, man-in-the-loop cockpits, high-performance computing, and warfare environment. These laboratories can work autonomously or collectively to provide varying levels of test and analysis capabilities.

APPROPRIATE USES:
Because of the robust and flexible modeling and simulation architecture created for the more stringent installed aircraft systems testing performed at ACETEF, a wide venue of other RDT&E capabilities have emerged and been exploited to support the systems development process. ACETEF has supported the systems development process from early mission needs and requirements development through operational testing and extending into training.

EQUIPMENT REQUIRED:
Simulation Support Team: The primary purpose of the Simulation Support Team (SST) is to provide and manage the infrastructure and resources which are shared throughout the facility. The SST is a core group which provides the High-Performance Computing (HPC) resources, facility instrumentation, facility configuration management, operations control, and hardware connectivity for the facility. HPC resources provide a powerful computer and graphics capability to meet unique modeling and simulation requirements theoughout DoD. This group provides the network infrastructure which brings together the various laboratories throughout the facility and connects the ACETEF to other Advanced Distributed Simulation sites.

Aircraft Simulation Team: The Aircraft Simulation Team (AST) provides the hi-fidelity virtual simulation of aircraft platforms. Within the AST there are several laboratory stations, a 40-ft. dome, and a 6-degree-of-freedom motion bay that are used for operating the various aircraft cockpit simulators available. Available cockpits to the customer include: F-18 A/C, F-18 E/F, V-22, F-14 A/D, and a Mission Reconfigurable Cockpit (MRC). Any cockpit within the AST can be placed into any of the standard configured labstations within a 30-min. turnaround time. Aircraft cockpit simulators typically include hi-fidelity aerodynamic and stick control flight models, real mission computers and displays, hi-fidelity out-the-window visual generation, and detailed avionics/weapon systems models. These cockpits can run standalone or integrated into a large-scale mission-level environment via DIS/HLA and/or the ACETEF architecture. Whenever the cockpits are tightly coupled into the ACETEF architecture, the pilot interacts with real aircraft systems from a live aircraft that is simulated within the anechoic

chamber.

Electronic Combat Simulation Team: The Electronic Combat Simulation Team (ECST) provides a dynamic hi-fidelity signal environment generation capability for stimulating hardware in-the-loop systems under test (SUT). This branch provides a robust interactive or scripted mission-level signal environment, depending on the test requirements. The SUTs, installed in aircraft or on a benchtop, are placed in an aircraft-size anechoic chamber, within a shielded hangar, or standalone within a laboratory. For dynamic scenarios, a mission-level warfare environment generator integrates and controls stimulators which radiate programmable communications signals; GPS signals; tactical datalinks (Link-4/11/16); strategic datalinks (TRAP, TADIX-B, TIBS, and OTCIXS); programmable radar signals; hi-fidelity, closed-loop threat radar, and missile simulators; infrared target stimulator; and a radar target stimulator. All radiated signals match the contents of the scenario in timing, power levels, and data content.

Warfare Simulation Team: The Warfare Simulation Team (WST) provides a variety of warfare environment and sensor modeling, and man-in-the-loop (MITL) simulation capabilities. One of the primary tools used within the WST is the Simulated Warfare Environment Generator (SWEG). SWEG is an interactive real-time mission-level warfare environment generator that represents the synthetic battlespace required for a multitude of RDT&E applications. It is a textural, language-driven simulation system, enabling both the physical and mental aspects of real-world entities to be represented conceptually within the simulation environment. SWEG can run in either a constructive mode or a virtual mode, allowing other simulations, simulators, stimulators, hardware, and people-in-the-loop devices to interact within a distributed simulation network. In either mode, SWEG generates the operational environment necessary to support the tactical interactions between all entities within the simulation environment. SWEG allows for the balanced modeling of both the mental and physical aspects of a conflict. It permits description of organizational structures, responsibilities, tactics, contingency plans, perceptions, memory, characteristics, and performance. Players within SWEG make tactical solutions according to perceived information of the conflict problem, not ground truth. SWEG can be used for test and evaluation, training, mission planning and rehearsal, force mix analyses, tactics and procedures development, cost and operational effectiveness analyses (COEA), requirements development, mission needs development, concept exploration, technology development, and studies and analyses. Because of the powerful warfare environment capabilities of SWEG and its real-time interface and interaction capabilities, it has been used extensively in support of many acquisition programs using virtual and constructive simulation. Another tool within the WST is the reconfigurable man-in-the-loop (MITL) stations which bring operators into the warfare mission space. These stations bring the behavioral inputs that are difficult to model, and are key to some tests and studies. The lab consists of several MITL stations which provide heads-up displays, keyboard, touch-sensitive heads-down displays, throttle and multi-function joystick. Though there is a large library of models and displays to choose from, the generic stations support rapid prototyping of interactive displays which can be tied to existing or new models. Once a station is configured, it is easily tied into the synthetic battlespace in order to participate and interact with other MITL and constructive simulation players.

INPUTS REQUIRED:
Many tests can be accomplished with existing ACETEF resources. However, unique test needs usually require that the user provide detailed scenarios, specifications for avionics and aerodynamics models, specifications for desired performance measures, and test plans. Test scenarios are controlled

by the Simulated Warfare Environment Generator (SWEG).

PROCESSING TECHNIQUES:
Processing techniques for input are many and varied.

OUTPUT:
Output consists of Gigabytes: All you ever wanted to know about your weapons system, but were afraid to ask.

USES OF OUTPUT:
Output is used for: 1) certification of integrated weapon systems (with operators-in-the-loop) as ready for operational test and evaluation; 2) evaluation of concepts for new systems and variants of deployed systems for new missions; and 3) source selection in procurements of advanced systems.

DOCUMENTATION:
Smullen, R.R., and Harris, S.D., "Air Combat Environment Test and Evaluation Facility (ACETEF)". In North Atlantic Treaty Organization Advisory Group for Aerospace Research and Development (AGARD) Conference Proceedings (No. 452, 'Flight Test Techniques.' Papers presented at Flight Mechanics Panel Symposium, Edwards Air Force Base, CA, 17-20 October 1988).

ALTERNATIVE/COMPARABLE APPROACHES:
No other facility has comparable high-fidelity simulation.

STAGE OF DEVELOPMENT:
ACETEF is fully operational and evolving. To obtain information, contact POC: Mr. R.R. Smullen, Deputy for Engineering, Code SY04, Systems Engineering Test Directorate, Patuxent River, MD 20670. Phone 301-342-6004 / DSN 342-6004.

COMMENTS:
ACETEF can provide unprecedented data on weapons systems with operators-in-the-loop. The facility routinely supports Joint programs. Operating costs provided upon request.

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: All-Digital(tm) Integrated Video Analysis (ADIVA)(tm) System

SPONSOR: C3D New Media Company
POINT OF CONTACT: Mr J Scott Carpenter / 408-353-4916
EMAIL: scott@c3dgraphix.com
RECORD NO.: HSI00167

GENERAL OVERVIEW:
The ADIVA system is an integrated analysis environment for viseo and recorded data. The system allows multiple video and data streams to be synchronized and reviewed for extraction of quantitative and qualitative information. Extracted information is identified both temporally and categorically, in event records. The event records form a database which can then be searched, queried and reported.

The digital video capabilities of ADIVA provide effortless manipulation of video. The video can be played at any speed forward or in reverse. It is possible to mark the video using externally created event markers, or to mark the video during real-time capture. The user can then jump to each marker and start their review, thus eliminating visual searching to find events of interest.

If numeric data is synchronized with the video, it may be displayed in single or multi-dimensional graphs. These graphs show data values over time, and have "time-now" markers to highlight momentary values. The data may be searched using inclusive or exclusive ranges, with individual events created for every period where a match is found.

Video and data graphs may be reported as video clips on tape, or in digital files. The clips can be sequenced into highlight tapes or incorporated into electronic reports. Event data can be reported or exported for use in downstream statistical packages.

ADIVA can output time-now data values to the network, where they may be read by real-time applications, thereby allowing other applications to be synchronized with ADIVA video and data streams.

APPROPRIATE USES:
ADIVA can be used for many applications where video and data must be reviewed after the original data collection session is complete. ADIVA is currently being used for human performance research, training, missile test analysis, medical device testing, zoological studies, air traffic communications studies, and sports team analysis.

EQUIPMENT REQUIRED:
UNIX; Windows NT (Oct. 1998); SGI O2 (Pentium II, Oct. 1998); 64MB RAM; 2MB hard drive; JPEG Video Capture, OpenGL 24-bit double-buffered graphics; video camcorder, data acquisition system of data playback is desired; recorded video can be used, therefore possibly replacing the camcorder with a VCR.

INPUTS REQUIRED:
NTSC or PAL analog color or b/w video, optional continuously sampled or discretely sampled data variables; video cameras and data acquisition software; sensors, simulators, flight data recorders, other instrumented equipment; continuously sampled data may be in one or more data arrays, and

discrete data in time-stamped, space-delimited files; all data in ASCII format; special input formats can be accomodated.

PROCESSING TECHNIQUES:
Review and analysis of recorded video and related data are performed to identify events of interest. These events may be classified and annotated to form a record about the event. Each event has a start time, and may also have a stop time, which can be used to calculate event durations. Event records may be queried to create subsets for review or reporting. Video may be edited to create "highlight" tapes.

Synchronized, recorded data is displayed as 1d, 2d, or 3d graphs. Real-time graphs are updated as video is reviewed, allowing simultaneous visual analysis of video and data. Review of synchronized data may be used as the primary means of locating events of interest by specifying inclusive or exclusive ranges of data values, whereby ADIVA will mark each occurrence where the data value is within the range. This technique can be used to find, categorize, and document data-related events.

OUTPUT:
Event records can be selected for reporting as either tabular listings or exported data files. A Time-Sorted Events Report and a Schema-Sorted Summary Report are provided. Event records may also be exported in a comma-separated ASCII text file suitable for many PC or MAC statistical packages. An Application Programmer Interface is provided for development of special reports, listings, and export formats.

Video clips for significant events may be captured, and may have data graphs overlaid on the video image. Clips may then be sequenced, have titles and captions added, and be recorded back to tape, or exported in a multimedia format for use on CD-ROM or the World Wide Web.

USES OF OUTPUT:
The database of event information may be used to create statistical analyses of the events in the video or data. These can be used for task analysis, workload analysis, crew resource management, situational awareness, communications, training effectiveness, usability, and physiological studies.

The analyst is not required to have special training or computer skills. The requirements relate more to the ability of the analyst to discern events of interest, and to properly categorize and annotate events. The system has been used successfully by subject matter experts with little or no computer training, and minimal instruction.

DOCUMENTATION:
ADIVA Users Guide; ADIVA Online Help System.

ALTERNATIVE/COMPARABLE APPROACHES:
MacSHAPA-ADIVA places more emphasis on sophisticated event data reduction, and less emphasis on statistical analysis.

STAGE OF DEVELOPMENT:
ADIVA is being continually enhanced. As of May, 1998, the current release is 2.01. The system may be downloaded from the Web site for evaluation.

VALIDATION:
Two validation studies were performed for the U.S. Navy at NAWC-AD Crewstation Technology Lab.

COMMENTS:
Training classes are available by special request. An ADIVA tutorial is provided in the User Guide and Online Help System.

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: Applied Cognitive Task Analysis (ACTA)

SPONSOR: Klein Associates, Inc
POINT OF CONTACT: Ms Laura Militello / 937-873-8166
EMAIL: laura@klein-inc.com
RECORD NO.: HSI00159

GENERAL OVERVIEW:
ACTA is an instructional software tool that is designed to assist practitioners in identifying cognitive skills, or mental demands, that are needed to perform a task. These skills/demands include: critical cues and patterns of cues; assessment, problem solving, and decision-making strategies; why these are difficult for novices; and common novice errors. ACTA provides a means for practitioners to elicit this kind of information and incorporate it into instructional design interventions.

APPROPRIATE USES:
Support tool for cognitive engineering and decision-centered design approaches to systems, user interfaces, and training interventions.

EQUIPMENT REQUIRED:
Minimum: 486 DX2-66 MHz, PCI or SCSI-2 device bus;16-bit Soundblaster-compatible speakers; video card with 2MB RAM, 64-bit data path; quad-speed CD-ROM; Windows 95, or Windows 3.1; standard screen size of 640 x 480, resolution setting for "thousands of colors".

INPUTS REQUIRED: N/A

PROCESSING TECHNIQUES: N/A

OUTPUT:
This is an instructional tool. Users of the software will learn to conduct applied cognitive task analyses.

USES OF OUTPUT: N/A

DOCUMENTATION:
Militello, L.G., Hutton, R.J.B., Pliske, R.M., Knight, B.J., & Klein, G. (1997), "Applied Cognitive Task Analysis (ACTA) Methodology", Fairborn, OH: Klein Associates, Inc. Final Technical Report prepared for the Navy Personnel Research and Development Center under Contract No. N66001-94-C-7034.

ALTERNATIVE/COMPARABLE APPROACHES:
N/A

STAGE OF DEVELOPMENT:
Version 1.0.

VALIDATION:
(See DOCUMENTATION, above.)

COMMENTS:
Additional POC: Josephine Randel
Navy Personnel Research and Development Center (NPRDC)
53335 Ryne Rd.

San Diego, CA 92152-7250
Phone: 619-553-7671 / FAX 619-553-7980

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: Articulated Total Body (ATB) Model

SPONSOR: Air Force Research Laboratory
POINT OF CONTACT: Dr Louise A Obergefell / 937-255-3665, DSN: 785-3665
EMAIL: lobergef@tweety.al.wpafb.af.mil
RECORD NO.: HSI00097

GENERAL OVERVIEW:
The Articulated Total Body (ATB) model is a computer simulation program developed by the Armstrong Laboratory (AL) for the prediction of human body dynamics during aircraft ejection, aircraft crashes, automobile accidents, and other hazardous events. It is a three-dimensional, coupled, rigid-body dynamics model, in which each body link is defined as a rigid segment.

APPROPRIATE USES:
Because of its capability to predict the motion and forces on the human body, manikins, seats, and other structures, the ATB model has broad applications in the automobile, aerospace and other transportation systems communities. It is used in the Air Force to determine the safety of restraint systems, seats, escape systems, controls and displays, and other equipment in the aircraft cockpit before prototypes are built or costly tests conducted. It is also used to provide data that cannot be measured during a test, such as forces within the body, and to supplement test data with parameter variation simulations.

EQUIPMENT REQUIRED:
The ATB model is written in FORTRAN77. It runs on most computers having a FORTRAN compiler, including personal computers, workstations, and main frames. Because of the program's size, 386 or higher personal computers are recommended.

INPUTS REQUIRED:
The input requirements for an ATB simulation include a description of the human or dummy body, the environment, the driving motion or force, and the initial conditions. The body data can be obtained using the Generator of Body (GEBOD) preprocessing program which calculates the required data for adult males, adult females, children, or test dummies.

PROCESSING TECHNIQUES:
The model uses the three-dimensional forms of Newton's Second Law and Euler's Equation as the equations of motion for each body segment, and Lagrange-type equations to apply the joint constraints. Constitutive equations are used to model body interactions with restraint belts, air bags, wind, and surrounding surfaces represented by planes and ellipsoids.

OUTPUT:
The program has many output options including data required for depicting the body motion, tabular data on the simulation status as specified time intervals, and time histories. A wide range of time histories can be generated for each simulation, including segment linear and angular positions, velocities, and accelerations; joint angles, and torques; body center of mass location, momentum, and kinetic energy; and contact, belt, and aerodynamic forces.

USES OF OUTPUT:
Varies according to output product/process generated.

DOCUMENTATION:
Obergefell, L., Gardner, T., Kaleps, I., and Fleck, J., "Articulated Total Body Model Enhancements, Volume 2: User's Guide, "Armstrong Laboratory Report No. AAMRL-TR-88-043, Wright-Patterson Air Force Base, OH, January 1988.

ALTERNATIVE/COMPARABLE APPROACHES:
The ATB model is also available in a complete software package, named DYNAMAN, which includes a user-friendly preprocessor for developing the database needed for a simulation, the ATB model, and a post-processor for plotting the body motion and graphing time history results. Dynamic models with features similar to the ATB include MADYMO, developed by TNO in the Netherlands, and MVMA3D by the Motor Vehicle Manufacturers Association.

STAGE OF DEVELOPMENT:
Complete and operable with revisions released periodically.
Write: Dr. Louise Obergefell
AL/CFBV
2610 Seventh St.
Wright-Patterson Air Force Base, OH 45433-7901

VALIDATION:
Numerous validation studies have been conducted for particular applications of the ATB model. Some validation efforts are documented in:

Fleck, J.T., Butler, F.E., and DeLeys, N.J., "Validation of the Crash Victim Simulator," Calspan Report No. ZS-5881-V-2, DOT-HS-806-290, Vol. 2 (NTIS No. PC E99, PB 86-212420), 1982.

Obergefell, L.A., Kaleps, I., and Steele, S., "Part 572 and Hybrid III Dummy Comparison Sled Test Simulations," SAE Paper No. 880639, Detroit, MI, February 1988.

Kaleps, I., "Prediction of Whole-Body Response to Impact Forces in Flight Environments," AGARD Conference Proceedings No. 253, Paris, France, 6-10 November 1978.

Smith, J. A., Rizer, A.L., and Obergefell, L.A., "Predictive Simulation of Restrained Occupant Dynamics in Vehicle Rollovers," SAE Paper No. 930887, Detroit, MI, 1-5 March 1993.

COMMENTS:
The ATB program was originally developed as the Crash Victim Simulator (CVS) and has been known as Cal3D.

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: Auditory Hazard Assessment Algorithm (AHAAH)

SPONSOR: Army Research Laboratory (ARL/HRED)
POINT OF CONTACT: Dr G Richard Price / 410-278-5976, DSN: 298-5976
EMAIL: dprice@arl.mil
RECORD NO.: HSI00178

GENERAL OVERVIEW:
Modern weapons produce intense acoustic impulses that pose a serious risk of hearing loss, which limits both their design and use. The civilian world also contains many noise sources that fall in the same category, e.g. automotive airbags, construction tools, sport shooting. Current noise exposure standards for impulse noise are not theoretically based, and it is generally agreed that they are seriously in error, especially for impulses with significant low-frequency energy. To meet the need to deal with hazard from sounds with peak SPLs above 130 db, HRED developed a mathematical model of the human ear that predicts the hazard from any free-field pressure, and provides a visual display of the damage process as it is occurring in the inner ear. The model is a powerful design tool because it not only provides a numerical rating of hazard, but also identifies specific parts of the waveform that are causing the hazard. This unique model can assess noise hazard from any intense sound, and has the potential both to serve as an international design standard and as a damage risk criterion for intense sounds.

APPROPRIATE USES:
Noise hazard assessment

EQUIPMENT REQUIRED:
Personal computer and AHAAH software

INPUTS REQUIRED:
Digitized acoustic waveform

PROCESSING TECHNIQUES:
AHAAH software

OUTPUT:
Numeric hazard values, and a movie of the development of hazard

USES OF OUTPUT:
Hazard assessment (damage risk criterion); design criterion; analysis of sources of hazard and their amelioration

DOCUMENTATION:
Read-me files included with this software.

ALTERNATIVE/COMPARABLE APPROACHES:
Nothing comparable.

STAGE OF DEVELOPMENT:
Algorithms functional; validation in progress.

VALIDATION:
In progress.

COMMENTS:

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: Automated Neuropsychological Assessment Metrics (ANAM)

SPONSOR: Naval Computer and Telecommunications Station (NAVCOMTELSTA)
POINT OF CONTACT: Ms Kathy Winter / 850-452-2601 x5531, DSN: 922-2601
EMAIL: k_winter_at_nctspens__n8@smtplink.ncts.navy.mil
RECORD NO.: HSI00082

GENERAL OVERVIEW:
The Automated Neuropsychological Assessment Metrics (ANAM) is designed with emphasis on both clinical and experimental applications which require repeated measures testing. A large pool of test items together with psuedorandomization techniques give each test a large number of multiple forms. This permits ANAM tests to be used during extended baseline testing and for monitoring performance over extended periods of time. ANAM tests are self-contained testing modules, easily re-configured and "fine-tuned" to compensate for individual differences and changes in environmental demands. Subject instructions are independent ASCII files for adaptation to multi-national or multi-cultural administration.

APPROPRIATE USES:
ANAM can be used in both research and clinical applications. Military research applications include monitoring cognitive status in exotic environments (i.e., 30-day undersea missions and Spacelab missions), and measuring effects of fatigue during Desert Storm B-1 bomber missions and of being wounded with depleted uranium bullets during Desert Storm. Clinical applications include quantifying inconstancy effects, tracking recovery of function, and assessing efficacy of therapeutic intervention on head injury patients. The repeated measures function allows for testing for differential effects of pharmaceutical treatment drugs.

EQUIPMENT REQUIRED:
The equipment required to run ANAM consists of an IBM AT-compatible PC with EGA or better video capability, a hard disk (software requires a minimum of 4 MB storage space), a graphics card, and at least 400K of memory. Response devices for all tests include either the computer keyboard or the Microsoft or Logitech Mouse.

INPUTS REQUIRED:
The ANAM menu, which will run a multi-test battery, prompts for subject ID, for dominant hand, for instructions on/off, for instruction file extension (for multi-language), for single test, full battery or restart, and for the location to store the subject's data, i.e., drive and subdirectory.

PROCESSING TECHNIQUES:
Subject's data is stored to the chosen disk and subdirectory. Traditional measures of response times, number correct/incorrect, means, medians, and standard deviations of correct/incorrect and response times are collected. Other measures, such as throughput, response lapse and bad response information, are also stored.

OUTPUT:
Three types of output files may be written and stored to disk. The summary dataset contains processed data, as listed in Processing Techniques. A report or text dataset is created and presents the summary statistics in a report format with titles and column headers. A raw dataset is created, which contains the stimulus presented, correct answer, subject's response,

and response time.

USES OF OUTPUT:
The summary dataset is formatted so that it can be easily exported to statistical packages, i.e., SAS, SPSS. The text report dataset allows a quick visual analysis of the individual test's data. Two utility programs are provided with the ANAM. One program allows summary files to be concatenated and viewed, providing a quick visual scan of the results of several tests simultaneously. The other program is used to select specified data items from the raw data files, producing concatenated raw data sets to export to statistical packages.

DOCUMENTATION:
Reeves, D.L., Winter, K., LaCour, S., Raynsford, K., Kay, G., Elsmore, T., and Hegge, F.W., "Automated Neuropsychological Assessment Metrics Documentation: Vol. I Test Administration Guide", Office of Military Performance Assessment Technology: Walter Reed Army Institute of Research, Washington, D.C., 1992.

ALTERNATIVE/COMPARABLE APPROACHES:
None known.

STAGE OF DEVELOPMENT:
Fully mature. To obtain, write: NAVCOMTELSTA, Code N81 (Ms. Kathy Winter), 130 West Ave., Ste. B, Pensacola, FL 32508-5111. Phone: 904-452-2601 or DSN 922-2601, ext. 5531.

VALIDATION:
ANAM has been validated. For specific validation information, contact the POC.

COMMENTS:
None.

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: BATMAN & ROBIN: Friendly Interfaces for Performance Measurement

SPONSOR: Naval Postgraduate School
POINT OF CONTACT: Dr Pat-Anthony Federico / 408-656-5719, DSN: 878-5719
EMAIL: federico@nps.navy.mil
RECORD NO.: HSI00007

GENERAL OVERVIEW:
BATMAN (Battle-Management Assessment System) is being developed to assess how well individuals can allocate, deploy, and manage air, surface, and/or subsurface tactical assets during simulated sea battles in many warfare areas. ROBIN (Raid Originator Bogie Ingress) is being developed to rapidly generate Red force raids comprised of a large number of air, surface, and/or subsurface tactical assets against Blue naval task forces or land bases in many warfare theaters. In order to complete the creation of a scenario, the user also specifies in ROBIN Blue force tactical resources that will be available in BATMAN for allocation, deployment, and management, as well as Green or neutral force air, surface, and/or subsurface movements.

Together BATMAN & ROBIN form a desk-top, computer-based, performance-measurement system incorporating high-resolution graphics, low-level modeling, and artificial intelligence techniques to fill the gap between board games that are run in real or fictitious time with subjective assessment and inappropriate feedback, and very expensive and manhour-intensive, mainframe-based simulators. Two of the major contributions of these dual systems are very friendly human-computer interfaces and automated performance measurement.

APPROPRIATE USES:
Because of the nature of their generic software and independent databases, as well as the potential for incorporating different computer models, BATMAN & ROBIN can be used for a variety of functions: a) training and testing tactical knowledge; b) planning and decision aiding for tactical situations; c) developing and evaluating tactics themselves; d) analyzing and evaluating various tactical sensor, weapon, and communication systems; e) front-ending sophisticated computer models and complex databases; f) interfacing tactical artificial intelligence and expert systems; g) generating scenarios rapidly for tactical trainers; h) prototyping complicated scenarios for major wargaming systems: i) orienting novices to facets of naval warfare; j) evaluating tactical display symbologies and formats; and k) providing an experimental environment for studying tactical decision making.

EQUIPMENT REQUIRED:
BATMAN & ROBIN are written in the C programming language and run on the Sun-4 family of computers, e.g., 110, 260C, 280S, Sparcstation 1, 2, 330, and 370, as well as the Navy's Desk-Top Tactical Computer (DTC) 2 under Sun Microsystems' Release 4.1.1 of the UNIX operation systems. These systems are completely documented and properly commented to facilitate integration of various validated and verified computer models to these friendly human-computer interfaces.

INPUTS REQUIRED:
ROBIN creates scenarios that can be saved and subsequently presented sequentially or randomly in BATMAN. Also, ROBIN can be used as a rapid scenario generator independently of BATMAN; i.e., it can be adapted to front-end systems such as BFIT (Battle Force Inport Trainer), and REAS

(Research, Evaluation, Analysis System), as well as others. BATMAN & ROBIN use databases which are independent of the simulation software to store the parameters, attributes, and characteristics of Blue, Red and Green platforms. Currently, these values are unclassified or sanitized; however, they can be made classified by using the friendly graphic interface.

PROCESSING TECHNIQUES:
Since they present an animated, computer-based, simulated-model metaphor, or microworld, to the user, BATMAN & ROBIN require direct manipulation of icons or graphic objects on the computer screen by using a mouse. These systems assume that the operator has some knowledge of Blue, Red, or Green force platforms, sensors, weapons, and tactics.

OUTPUT:
BATMAN assesses the tactical decision making of the individual managing the entire battle, or any of its components, in terms of composite warfare structure by measuring performance automatically and objectively against multivariate criteria which are immediately fed back to the user at the end of each scenario. These measures are saved by the system for subsequent statistical analyses, and are available for formative and summative evaluations of performance.

DOCUMENTATION:
"Human-Computer Interfaces for Tactical Decision Making, Analysis, and Assessment Using Artificially Intelligent Platforms: Volume 1, Software Design and Database Descriptions for BATMAN & ROBIN," NPRDC TN 91-20.

ALTERNATIVE/COMPARABLE APPROACHES:
None are known at this time.

STAGE OF DEVELOPMENT:
Direct-manipulation human-computer interfaces for electronic warfare, neutral or Green forces, and a relational database for platform parameters have been added to BATMAN & ROBIN. Artificially intelligent or smart platform behavior for executing different missions employing hybrid cognitive modeling and using knowledge-based finite-state automata has been incorporated into these systems. The source code has been converted from Sun-View to X-View, which is X-Windows-compatible to facilitate: (1) the software running on many more machines, e.g., SGI Indigo; and (2) the networking of heterogeneous machines. Recently, human-computer interfaces have been added for: 1) placing on particular platforms for different scenarios specific emitters and weapons which have been selected from generic lists; and 2) boarding any Blue surface platform in BATMAN as the tactical action officer, displaying relevant air, surface, subsurface contact information, and assigning specific weapons to certain targets.

TO OBTAIN:
These unclassified systems will be provided to Department of Defense (DoD) organizations for specific research and development projects, if the commanding officer of the requesting agency, or someone comparable, signs a formal Memorandum of Agreement with the commanding officer of NPRDC restricting the use of BATMAN & ROBIN. For example, these systems are not to be employed for tactical training and testing at this time.

Anyone interested in using these systems contact: Dr. Pat-Anthony Federico, NPRDC, Code 13, 53335 Ryne Rd., San Diego, CA 92152-7250; voice (619) 553-7777; DSN: 553-7777; Fax: (619) 553-0477; network address: federico@nprdc.navy.mil. Strongly suggest that those interested call before preparing a written request.

VALIDATION:
The computer models and databases currently have not been validated or verified. The development has focused on creating the human-computer interfaces - not the computer models or databases which are already widely available throughout DoD.

COMMENTS:
The generic nature of BATMAN & ROBIN allows the user to add or delete platforms at will without rewriting the software. Also, the modularity of the code permits the incorporation of different computer models for various sensor, weapon, communication, and environmental systems. The Sun-4 family of computers allows the running of models written in different languages simultaneously, e.g., "C", ADA, MODULA-2, FORTRAN-77, PASCAL, and COMMON LISP.

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: Boeing McDonnell Douglas Human Modeling System (BMD-HMS)

SPONSOR: The Boeing Company
POINT OF CONTACT: Ms Terri B Graham / 562-496-9511
EMAIL: theresa.b.graham@boeing.com
RECORD NO.: HSI00187

GENERAL OVERVIEW:
The Boeing McDonnell Douglas Human Modeling System (BMD-HMS) is a software tool designed specifically for engineering applications. BMD-HMS is a menu-driven, interactive computer program used to define human factors design requirements and aid in design evaluation. BMD-HMS provides a powerful set of human modeling and human task simulation tools that allow the user to establish design-to requirements, test reach accomodation, study human motion, and perform various fit and function evaluations of their present design.

APPROPRIATE USES:
The primary purposes of the BMD-HMS are to assist in formulating human factors design requirements, and to aid evaluations of human interaction with work site designs. The major benefits of using human modeling in electronic design include: (1) reducing the need for physical development fixtures by performing evaluations electronically; (2) reducing design costs by enabling the design team to more rapidly prototype and test a design; (3) avoiding costly design 'fixes' later in the program by considering human factors requirements early in design; and (4) improving customer communications at every step of product development by using compelling animated graphics.

EQUIPMENT REQUIRED:
Silicon Graphics 5.3 or later; Hewlett Packard 9.05 or later; mimimum 100 Mhz CPU; minimum 24 MB RAM; minimum 30 MB hard drive; Extreme Graphics or higher-end video card; 4mm DAT tape drive or Internet required to install software.

INPUTS REQUIRED:
BMD-HMS provides for manikin interaction with electronic representations of the work environment; therefore, the electronic or virtual work environment (e.g., CAD drawings of cockpit) must be input. BMD-HMS can download engineering geometry from CAD systems. The geometry definitions of the work environment are accessed by a versatile user interface program. Typical data source: 3D CAD data. CAD data input formats: IGES (Initial Graphics Exchange Specification); STL (Stereo Lithography).

PROCESSING TECHNIQUES:
Since BMD-HMS can download engineering geometry from CAD systems, the user does not have to re-create the CAD geometry in the local evaluation environment. However, it may be necessary to specially prepare the engineering geometry definitions in order to effectively analyze human interfaces with the defined geometry.

BMD-HMS generates realistic human form images, or manikins, by using manikin dimensioning algorithms and one of the seven anthropometric databases. Inverse kinematics and biomechanical databases permit realistic simulation of human motion and manikin interaction with the virtual work environment. Manikin motion is driven by an inverse kinematic algorithm which is

controlled by workfile simulation, or by interactive user commands. BMD-HMS' simulation module uses 'workfiles' to create and control manikin motion and drive geometry through motion paths. Current methods of human factors analysis include:

- Vision & Vision Obscuration Plots
- Distance Analysis
- Collision Detection
- Automated Population Analysis
- Reach Accomodation
- Reach Envelopes
- Static Volume Envelope
- Torque Calculator

OUTPUT:
Current BMD-HMS outputs include:

- Static and dynamic graphical images: Help to visualize and analyze the actions required to assemble, maintain, and operate equipment.
- Manikins: Can be uploaded to the CAD system to illustrate clearance and posture information.
- Vision Obscuration Plots: Generates a plot of visually obscured areas to define the surfaced area which cannot be seen in the immediate surround due to objects that intervene in the space between the manikin's eyes and objects of interest; for example, vision obscuration plots can be generated with a manikin positioned at the design eye point (DEP) within an aircraft cockpit. These plots can be exported to the host CAD system and used to test design compliance for visual access to primary flight displays.
- Automated Population Analysis: (1) Identifies obstructions to reach, or clearance required for successful task completion or physical accomodation of the user population. It generates a report of interferences within the current design configuration for a population sample using collision detection. The results of this analysis can be used to evaluate the current design and to facilitate definition of design change requirements. (2) Provides option for generating a manikin positioning reference point for each manikin within the population sample; for example, aircraft pilot seat travel requirements can be defined, or existing seat travel can be evaluated. For each manikin in the population sample, a reference point is generated offset from the current seat reference point (SRP) in relation to the cockpit DEP. The location of this point is such that if the manikin was positioned at an SRP that was located on the generated point, the manikin would be located exactly at the DEP. The cloud of points generated for the entire population sample can then be used to quantify seat travel requirements, or can be used to evaluate existing seat travel.
- Reach Accomodation: Analyzes reach to predict what percent of a population can successfully perform the task under study. It generates a report which includes the percent of the population that is accomodated by the current design configuration. Report options also include indication of success or failure for each manikin to perform reach, including miss distances. The results of the reach accomodation can be used to evaluate the current design, and to facilitate definition of design change requirements.
- Reach Envelope Generation: Generates a graphical, 3D representation of the volume within which an individual manikin or population sample can reach. This reach envelope can be exported to the host CAD system and used as a design-to requirement. The reach envelope can also be used to evaluate the current design configuration to ensure that the user population can successfully reach and operate all required controls.
- Static Volume Envelope Generation: Generates a graphical, 3D representation of the volume of space required to ensure that an individual

manikin or population sample has adwquate static body clearance. This static volume envelope can be exported to the host CAD system and used as a design-to requirement. The static volume envelope can also be used toevaluate the current design configuration to ensure physical accomodation of the user population.

- Torque Calculator: Measures reactive forces and torques at each joint for a stationary manikin in a given posture. The results of the torque calculation can help determine whether the design force required is compatible with human capabilities.

USES OF OUTPUT:
BMD-HMS has been used in many engineering applications, and has demonstrated its value and versatility as a design tool. For the primary purposes of BMD-HMS, see APPROPRIATE USES and OUTPUT, above.

Analyst qualifications: Training required - minimum of working through online tutorials; some knowledge of CAD and Human Factors helpful.

DOCUMENTATION:
Installation Guide (on Website); Reference Manual (online); Applications Tutorial (online); Validation Manual (online)nual (online)

ALTERNATIVE/COMPARABLE APPROACHES:

STAGE OF DEVELOPMENT:
Version 3.0 available for licensing by special arrangement; evaluation copies available; Version 4.0 in development.

VALIDATION:
The online Validation Manual is comprised of four manikin-body-segment-dimension validation studies (Chapters 1, 2, 4, and 5), and one manikin-reach validation study (Chapter 3). Additional internal (Boeing) validation studies have been conducted to demonstrate compliance with requirements related to Intravehicular Activity (IVA) human anthropometry.

COMMENTS:
No-cost licensing of BMD-HMS to non-DoD institutions (e.g., academic and research institutions) can be arranged on a case-by-case basis.

Training available: online tutorials; 8-hr. introductory class; 8-hr. intermediate class.

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: Carlow Usability Test Tool for Evaluation and Research (CUTTER)

SPONSOR: Carlow International, Inc
POINT OF CONTACT: Mr Clifford C Baker / 703-698-6225
EMAIL: cliffbaker@carlow.com
RECORD NO.: HSI00156

GENERAL OVERVIEW:
The Carlow Usability Test Tool for Evaluation and Research (CUTTER) is part of the IDEA and SHIPSHAPE tool sets. It offers three modules to support all phases of usability testing. These modules are: 1) a test preparation and planning support module; 2) a data-logging and data analysis module; and 3) an interface evaluation guideline module.

The test preparation and planning support module assists in the development of usability test plans and data collection forms. The module tailors and formats participant demography data forms, subject consent to participate forms, task checklists (supporting generations of test scenarios), laboratory setup checklists, and scenario development. The module outputs hardcopies of forms and data that can be edited using a text editor, or used directly in test plans. The tool contains an outline of a generic usability test that can be modified to meet most usability test planning needs.

The data-logging and analysis module helps in the collection of task performance data and time-on-task data. This module defines specific keystrokes as the initiators and terminators of any discrete task performed. Using easily definable function keys, task performance data can be collected in real time and subsequently analyzed by the software. During data collection, test personnel observe subjects and enter single keystrokes that begin time- and task-logging for each task in the taxonomy. Each incidence of the initiation of a task can be annotated either in real time or after testing. The software automatically analyses the data and reports:

- time spent performing each task category in terms of total time on each task, and percent of total time spent on each task (e.g., "8% of total time spent in navigating screens")
- task counts and frequencies (e.g., "HELP queried a total of 6 times, or once every 4 minutes")
- task annotations (if entered in real time)
- error counts.

The interface evaluation module allows the usability engineer to search a library of over 1,000 user interface guidelines, and apply any subset of them to any computer interface under evaluation. Complex search and selection algorithms are provided, as well as the ability to print hardcopies of evaluation checklists, or to conduct evaluations "online." The software also allows for in-depth reporting of the results of a guideline-based usability evaluation. This module can be used to evaluate an interface where no actual usability study (task performance observation) is being performed.

APPROPRIATE USES:
Usability test planning (scenario generation, selection of performance measures, development of test procedures), usability test conducting (data-logging, data reduction, and computation of descriptive statistics), report generation, application of UCI standards to interface under development or test.

EQUIPMENT REQUIRED:
- Apple(r) Macintosh running System 6.0 or higher
- HyperCard 2.1 or later
- Minimum of 8 megabytes of RAM, 3 megabytes of hard disc drive space

INPUTS REQUIRED:
The software guides the test developer through test plans development, to test conducting, to data evaluation and reporting. Major inputs are descriptions of the device/software to be tested, and use characteristics.

PROCESSING TECHNIQUES:
Task-activity logging, computation of descriptive statistics, report generation (event tables), and database searching.

OUTPUT:
Task-activity logs, descriptive statistics, reports, objective measures of human performance using the device tested, subjective (user) measures, identified interface design improvements, usability predictions, inputs to user documentation, customer support plans, and training requirements.

USES OF OUTPUT:
Interface redesign, problem reports, documentation inputs, and quantified inputs to tradeoff decisions.

DOCUMENTATION:
Carlow Usability Test Tool for Evaluaton and Research (CUTTER) User's Guide.

ALTERNATIVE/COMPARABLE APPROACHES:

STAGE OF DEVELOPMENT:
Complete.

VALIDATION:
Statistical/computational modules validated analytically. Database, data-logging, and reporting modules validated analytically. Planning modules validated subjectively.

COMMENTS:
The importance of the design for usability in software development is evident in that: a) the human-computer interface comprises from 47% to 60% of the total lines of code; b) a graphical user interface accounts for at least 29% of the software development budget; and c) 80% of costs associated with the software life cycle (design, development, implementation, and maintenance and operation) accrue during the post-release maintenance phase of the life cycle, and furthermore, 80% of this maintenance is attributable to unmet or unforeseen user requirements. Therefore, 64% of the life cycle costs associated with a software system is due to changes required to improve the interface between user and computer.

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: COMBIMAN - COMputerized BIomechanical HuMAN-Model

SPONSOR: Air Force Research Laboratory
POINT OF CONTACT: Dr Joe W McDaniel / 937-255-2558, DSN: 785-2558
EMAIL: jmcdaniel@falcon.al.wpafb.af.mil
RECORD NO.: HSI00008

GENERAL OVERVIEW:
COMBIMAN is a 3-D interactive, computer-graphics model of an aircraft pilot, (or other vehicle operator), which is used to evaluate the physical accommodation of an existing or conceptual 3-D crew system design.

COMBIMAN has capabilities available in no other human model, namely the comprehensive databases and models of human physical performance in the actual situations modeled. COMBIMAN performs four categories of analyses: fit, visual field, strength for operating controls, and reach capability with the arms and legs. The user has many options in sizing and proportioning the human model of both male and female crew members, the encumbrance of six types of clothing and Personal Protective Equipment (PPE), and mobility limitations for lap belts and shoulder harnesses.

APPROPRIATE USES:
COMBIMAN can assist in evaluating the physical accommodation of the crew member in a cockpit or other vehicle. Used as an electronic mockup, COMBIMAN allows the user to perform the same evaluations possible with a hardware mockup without the disadvantages of having to select representative subjects. COMBIMAN can evaluate any sit-down workplace, including wheelchairs.

EQUIPMENT REQUIRED:
Windows NT or 95; Unix; Aix; MVS/XA; Sun SPARCstation; IBM RS6000 Model 320 or higher; Pentium-based PC or IBM mainframe; minimum 32 MB RAM (64 preferred); 12 MB hard drive; video card depends on hardware and CAD system (as appropriate).

Software programs depend on resident CAD system. Current interfaces are available for CATIA, AutoCAD, I-DEAS VI, and CADCAM. The user must have one of these CAD systems to run software for human models.

COMBIMAN runs on the same mainframe and UNIX workstations and PCs, running Windows NT or 95, that host commercial CAD systems, such as CATIA, CADCAM, I-DEAS, and AutoCAD. Since COMBIMAN is interfaced directly to existing commercial CAD systems used by manufacturers, the program does not require users to transfer the design to another system; rather, COMBIMAN enters the user's own CAD drawing. Updated interfaces for the above CAD systems are in progress -- such as CATIA V4 for COMBIMAN, and AutoCAD V14. For more information, contact CSERIAC.

INPUTS REQUIRED:
Prior to using COMBIMAN, the user must have created a 3-D representation of the workstation using the host CAD system. Minimum level of detail is three 3-D points, two to locate and orient the human model, and a third to represent the location of the point to be reached/operated. Only workplace features interacting with the human need be modeled. If not already present, the user should define the points in the workplace drawing before the analysis, but this can also be done during the analysis. If the workplace

drawing must be imported from another system, a translator may be required, such as STEP (STandard for the Exchange of Product model data), or IGES (Interactive Geometry Exchange Standard) translation package to bring the model into one of the required CAD systems.

PROCESSING TECHNIQUES:
The user defines the body size by selecting a percentile or keying-in a value for: (a) twelve direct measures to define an individual; (b) two measures to generate a statistically appropriate model from one of six resident anthropometric surveys; or (c) selection of a predefined subject from the database. Six anthropometric surveys are included: USAF male and female pilots, USAF women, Army male pilots, Army women, and Navy male pilots. Strength models are based on USAF male and female pilots. The user answers a series of prompting questions that define the operator tasks to be simulated. Categories of tasks include reach-to and apply-force-to all types of controls, view displays, and outside a vehicle. The user defines the task to be simulated by selecting plain-language descriptors from menus, similar to telling a human subject what to do in a seated workplace (sit here, face this way, reach this control, look at this display, etc.). On-line HELP explains the choices. The COMBIMAN software automatically causes the human model to execute the task and display the results. Expert system software prevents accessing inappropriate models and databases, and automatically creates the correct body size and proportions for males and females, the encumbrance of clothing, PPE, and mobility. If appropriate, obstacles are avoided when reaching controls.

OUTPUT:
Output displays the 3-D model in the workplace performing the final configuration of the task, illustrating whether or not the fit or reach is feasible. Custom strength capabilities (distribution from weak to strong) are shown in a table. Graphical plots show COMBIMAN's view of the workstation, including obscuration of head gear.

USES OF OUTPUT:
The output can be used for early identification of potential design-induced accommodation problems, so that a problem may be corrected before mockup, fabrication, or production. Strength values are maximum safe performance.

Examples of COMBIMAN's use include: evaluating five potential locations for a new Control-Display Unit (CDU) in the T-38 cockpit; analyzing visibility limits of pilots and co-pilots in B-52 cockpits; and evaluating reach and visibility on the F-16.

Knowledge of both the CAD system and the human model is required. Ideally, a team with one CAD user and one human factors engineer is practical.

DOCUMENTATION:
COMBIMAN has a three-volume user's manual: Volume I discusses the interface to the user's CAD system; Volume II discusses the operation of the COMBIMAN model; Volume III discusses the makeup of the models and techniques for performing workplace accommodation analyses.

McDaniel, J.W. (1997). CAE Tools for Ergonomics Analysis. In Andre, T.S. and Schopper, A.W., Human Factors Engineering in System Design [Chap. 5, pp 100-140], Crew System Ergonomics Information Analysis Center SOAR 97-03, Wright-Patterson AFB, OH.

ALTERNATIVE/COMPARABLE APPROACHES:
Human subjects, which may not represent the user population, can be

evaluated in mockups of the workplace.

STAGE OF DEVELOPMENT:
COMBIMAN is under continuous product improvement. New data and models are added as available. Requesters get the latest version. First distributed in 1978, Version 11 is currently available. It has been used by the Air Force to evaluate design changes, saving the costs associated with hardware mockups and prototypes.

To obtain, write or 'phone: Crew System Ergonomics Information Analysis Center, AFRL/HEC/CSERIAC, Bldg. 248, 2255 H St., Wright-Patterson AFB, OH 45433-7022, (937) 255-4842 / DSN 785-4842.

VALIDATION:
COMBIMAN is a system of integrated, interactive models of empirical data, each of which has been validated. The main feature that distinguishes it from other human models is the quality of data modeled, the fact that the models are compatible, and that the models answer the questions asked by workplace designers. COMBIMAN was developed by the Air Force at a cost of millions of dollars and a research and development effort of more than 15 years. Much of the data modeled, especially the female data, is not available elsewhere.

COMMENTS:
While CSERIAC has a small shipping and handling charge, there is no charge for the COMBIMAN software itself. Training is available at cost from developers of the software.

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: Computer-Aided Systems Human Engineering (CASHE)

SPONSOR: Air Force Research Laboratory
POINT OF CONTACT: Dr Don Monk / 937-255-8814, DSN: 785-8814
RECORD NO.: HSI00010

GENERAL OVERVIEW:
CASHE is a human factors information test bench. Distributed on CD-ROM, this interactive, hypertext system supports four primary functions: 1) retrieval of information from and navigation within the information base, consisting of the complete Engineering Data Compendium, MIL-STD-1472D, and user-created files; 2) annotation of the information base to augment its personal meaning and value (annotations include attaching notes to information objects, linking together objects, marking objects for subsequent recall, and developing personal indices of terms, and then linking these terms to objects in the information base); 3) experiential understanding of human perception and performance phenomena via the integrated Perception and Performance Prototyper (P3) (browsing of the text improves recognition of the material in other contexts, and the understanding of the factors that control their expression); and 4) manipulation and transportation of quantitative relationships contained in the information base or brought in from external sources.

Both quantitative and graphical manipulations are supported. As with experiencing phenomena first-hand, this functionality is expected to promote recognition and understanding.

APPROPRIATE USES:
CASHE will allow: 1) improved access to human performance data via the electronic databases; 2) improved understanding of that data via interactive data graphs and data simulations; and 3) improved application of the information via the prototyping capabilities of the P3. The goal of CASHE is to integrate that information with engineering design efforts in order to achieve a match between operator characteristics and specifications for all types of military and industrial systems.

EQUIPMENT REQUIRED:
The minimum required equipment is Apple MacIntosh II, with at least a 13" monochrome display, 8 MB memory, 10 MB of available hard drive space, and a CD-ROM drive. The preferred equipment is Macintosh PowerPC with at least a 13" color display, 8 MB of memory, 27 MB of available hard drive space, and a CD-ROM drive.

INPUTS REQUIRED:
The system is self-contained, but other data may be imported into CASHE, allowing for user-supplied data to be compared with the on-line reference data.

Multiple methods exist for accessing and navigating the database: browsing, simple text searches, directed Boolean queries, hypertext linking (both system- and user-defined), table of contents indices, back-of-the-book indices, glossaries, and design checklists.

OUTPUT:
CASHE will provide relevant information to the design engineer. It can be used as a means to explore human behavioral phenomena. Retrieval of

information will be supported by bookmarks to allow recall of selections, cut-and-paste operations to allow export of useful information, and other features that allow the creation of personal notes and search strategies. Several of the P3 modules save experimental results and settings to a text file for use in post-processing applications.

USES OF OUTPUT:
The output of CASHE can be used to incorporate human engineering principles and data into the system design process.

DOCUMENTATION:
Boff, K.R., and Lincoln, J.E., (eds.), "Engineering Data Compendium: Human Perception and Performance," Armstrong Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH, 1988.

"Military Standard: Human Engineering Design Criteria for Military Systems, Equipment and Facilities," MIL-STD-1472D, U.S. Army Missile Command, Redstone Arsenal, AL, 1989.

ALTERNATIVE/COMPARABLE APPROACHES:
None known.

STAGE OF DEVELOPMENT:
Available. To obtain, write: Dr. Don Monk, AFRL/HECA, Bldg. 248, 2255 H St., Wright-Patterson AFB, OH 45433-7022.

COMMENTS:
"Perception and Performance Prototype (P3)" software has been integrated into the CASHE program (see HSI00037).

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: Computerized Instructional System for Tasks, Objectives, Media, and Sybilli-Clipperized (CISTOMS-C)

SPONSOR: Headquarters Air Education & Training Command
POINT OF CONTACT: Mr Robert L Denton / 210-652-3194, DSN: 487-3194
EMAIL: dentonr@rndgatel.aetc.af.mil
RECORD NO.: HSI00163

GENERAL OVERVIEW:
CISTOMS-C is an instructional systems development (ISD) analysis tool for front-end training system requirements analysis (TSRA) efforts.

APPROPRIATE USES:
CISTOMS-C performs most early ISD functions in an integrated way.

EQUIPMENT REQUIRED:
IBM PC XT/AT, 256KB RAM, 1MB storage, diskette input, dot matrix or laser printer; MS-DOS 2.0 or higher, Clipper or Blinker programming language.

INPUT REQUIRED:
Users should be ISD training analysts, and be familiar with USAF ISD process.

PROCESSING TECHNIQUES:
CISTOMS-C (Version 1.0) is designed for aviation/ground-based training. Characteristic category names cannot be changed. There is no online help function.

OUTPUTS:

USES OF OUTPUT:

DOCUMENTATION:
Technical document: "AF Primary Aircraft Training System CSPE1: CISTOMS-C", Manuals, Ref. No. F33657-89-D-2-2157/4, May, 1993.

User instruction: "CISTOMS-C Manual, Vol. 1: Users Guide", May, 1993.

ALTERNATIVE/COMPARABLE APPROACHES:

STAGE OF DEVELOPMENT:
Complete and in use.

VALIDATION:
Study: "AF Primary Aircraft Training System (AFPATS) TSRA", Report No. F33657-89-D-2157/004, May, 1993, JWK International Corp., Systems Training Div., (513) 254-4400.

COMMENTS:
CISTOMS-C is not derived from, but is based on, the ISD concepts found in TASCS III+.

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: ComputerMan

SPONSOR: Army Research Laboratory
POINT OF CONTACT: Mr Howard M Kash / 410-278-6507, DSN: 298-6507
EMAIL: hmkash@arl.mil
RECORD NO.: HSI00101

GENERAL OVERVIEW:
The ComputerMan Model is a software tool (written in C++) for studying the effects of penetrating injuries to personnel. This model is designed to simulate the wounding process and to predict injury outcomes in terms of performance degradation and survivability. As such, ComputerMan is being used in weapons assessment studies, as well as in vulnerability assessments.

ComputerMan is a model designed to simulate wounding and the resulting performance degradation, as well as threat-to-life, caused by fragment impacts. It can be used to establish the wounding power of fragments in weapons effectiveness studies, and to address vulnerability issues, such as the effectiveness of body armor. The human anatomy is represented and stored in the model in the form of 167 horizontal cross sections, each of which is further subdivided into 5mm x 5mm cells, resulting in a tissue database of 124,000 cells. Approximately 280 different tissue types are identified with a level-of-detail which includes nerves and blood vessels. The anatomical description can be articulated so that the man can be seated in a crew compartment and thus be considered in a total weapon system assessment. This model draws upon an extensive database which includes information on 14 different projectiles ranging in mass from 0.5 grain to 225 grains, and includes 4 shapes and two densities. These data have been generalized and formulated into predictive models of tissue hole-size and projectile velocity retardation. Expert medical knowledge is also built into the model to relate wound description to injury severity and resulting limb dysfunction. Performance degradation is determined based upon combat role and time after wounding. Survivability predictions are based upon the Abbreviated Injury Scale (AIS).

APPROPRIATE USES:
Establishment of the wounding power of fragments in weapons effectiveness studies and addressing vulnerability issues, such as the effectiveness of body armor.

EQUIPMENT REQUIRED:
Interactive, color workstation running X-Windows, with Motif libraries, and a C++ compiler.

Batch: C++ compiler.

INPUTS REQUIRED:
Fragment properties (mass, velocity, density, shape)
Soldier properties (posture, body armor type)
Shotline properties (hit location(s), trajectory)

PROCESSING TECHNIQUES:
ComputerMan can be run either interactively or in batch mode. Four different modes of operation are: single-shot, grid-shot, live-fire test-shot, and point-burst-shot. Single-shot mode is used to process a single fragment shotline, and produce a resulting level of performance degradation and

probability of survival. Grid-shot mode processes an array of parallel shotlines over a region of the body, and is used to develop average values of incapacitation and survival probability. Live-fire test-shot mode is used to analyze the results of live-fire tests where multiple impacts to the body are produced. Point-burst mode is used to simulate the cone of fragments produced from an exploding munition or from behind armor spall.

OUTPUT:
Output consists of levels of performance degradation for four common tactical roles (assault, defense, reserve, and supply) and six post-wounding times (30s, 5min, 30min, 12hrs, 24hrs, 5days). Probabilities of survival are also output.

USES OF OUTPUT:
The output can be used to determine the ability of a soldier to complete his assigned task, and the soldier's probability of survival. For grid-shots, curves can be developed for ranges of fragment parameters such as mass and velocity.

DOCUMENTATION:
Saucier, Richard, and Howard M. Kash III. "ComputerMan Model Description", ARL-TR-500, U.S. Army Research Laboratory, Aberdeen Proving Ground, MD, August 1994.

ALTERNATIVE/COMPARABLE APPROACHES:
None known.

STAGE OF DEVELOPMENT:
Version 2.1 of ComputerMan is currently available.

VALIDATION:
ComputerMan has been effectively used in the prediction of Live-Fire Test (LFT) crew casualties and in the analysis of various types and configurations of body armor.

COMMENTS:
Distribution of this tool is unlimited within DoD. Some distribution restrictions may apply to organizations outside of DoD. Please contact the POC for an availability determination.

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: CREW CHIEF - A 3-D Computer-Graphics Model of a Maintenance Technician

SPONSOR: Air Force Research Laboratory
POINT OF CONTACT: Dr Joe W McDaniel / 937-255-2558, DSN: 785-2558
EMAIL: jmcdaniel@falcon.al.wpafb.af.mil
RECORD NO.: HSI00013

GENERAL OVERVIEW:
CREW CHIEF is a 3-D model of a maintenance technician which evaluates physical accommodation and maintainability in existing or conceptual workplaces. It interacts directly with a CAD drawing as an electronic mockup. CREW CHIEF has capabilities available in no other human model, namely the comprehensive databases and empirical models of human physical performance measured in the actual situations modeled. Users select from a range of different-sized male and female subjects in the size range of 1st to 99th percentile, four types of clothing and personal protective equipment (fatigues, coat, artic, and chemical protection), and twelve working postures. Users can automatically simulate and analyze physical accessibility for reaching into confined areas (with hands, hand tools, and objects), visual access (evaluating what the CREW CHIEF can see), and strength capability (for both tool use and materials-handling tasks).

APPROPRIATE USES:
CREW CHIEF analyzes fit, vision, reach, and strength. Unique empirical models of maximum safe strength capability include: applying torque with wrenches in 9 working postures as a function of bolt orientation, wrench type, wrench orientation, and barriers; dynamic lifting in 9 postures as a function of lift height, object size, type of handles; pushing in 10 postures; pulling in 10 postures; carrying in 4 postures; holding in 7 postures; and applying torque with hands-on electrical connectors. Reach includes automated obstacle avoidance. Fit and motion envelope of tools uses its own 222-piece hand tool set. Because the work elements modeled are components of physical activities in most types of work, CREW CHIEF has been used for manufacturing tasks, construction tasks, etc.

EQUIPMENT REQUIRED:
Windows NT or 95; Unix; Aix; Sun SPARCstation; IBM RS6000 Model 320 or higher;MVS/XA or Pentium-based PC; minimum 32 MB RAM (64 MB preferred); 12 MB hard drive; video card depends on hardware and CAD system (as appropriate).

Software programs depend on resident CAD system. Current interfaces are available for CATIA, AutoCAD, I-DEAS VI, and CADCAM. The user must have one of these CAD systems to run software for human models.

CREW CHIEF runs on the same mainframe and UNIX workstations, as well as PCs running Windows NT or 95, that host commercial CAD systems, such as CATIA, CADCAM, I-DEAS, Computervision, and AutoCAD. Since CREW CHIEF is interfaced directly to existing commercial CAD systems used by manufacturers, the program does not require users to transfer the design to another system; rather, CREW CHIEF enters the user's own CAD drawing. Development of updates to CAD interfaces is in progress, including an interface to AutoCAD 14 on a PC. For more information, contact CSERIAC.

INPUTS REQUIRED:
Prior to using CREW CHIEF, the user must have created a 3-D workplace

drawing on the host CAD system. Minimum level of detail is three 3-D points, two to locate and orient the human model, and a third to represent the location of the point to be reached/operated. Only workplace features interacting with the human need be modeled. If not already present, the user should define the points in the workplace drawing before the analysis, but this can be done during the analysis. If the workplace drawing must be imported from another system, a translator may be required, such as STEP (STandard for the Exchange of Product model data), or IGES (Interactive Geometry Exchange Standard) translation package to bring the model into one of the required CAD systems.

PROCESSING TECHNIQUES:
The user selects the desired gender, body size, clothing combination and working posture, after which CREW CHIEF is inserted into the workplace drawing. The user answers a series of prompting questions which defines the maintenance task to be simulated. Categories of tasks include operations with all common hand tools and manual materials handling. Size represents Air Force or Army men and women, but strength models are based on Air Force male and female maintainers. The user defines the task to be simulated by selecting plain-language descriptors from menus, similar to telling a human subject what to do in an actual workplace. On-line HELP explains the choices. Once the task is defined, the analysis is automatic.

OUTPUT:
Output displays the 3-D model in the workplace performing the final configuration of the task, illustrating whether or not the fit or reach is feasible. Custom strength capabilities (distribution from weak to strong) for tool or materials-handling tasks are shown in a table. Graphical plots show Crew Chief's view of the workplace. Interference between model or tool and workplace features is shown. Visibility plots show obscuration of head gear.

The output consists of the correct body size and proportions for males and females, the encumbrance of clothing, PPE, mobility, physical access for reaching into confined areas (with hands, tools, and objects), visual access, and strength, as well as a 3-D human model superimposed on the user's design, which performs the defined task.

USES OF OUTPUT:
Uses are similar to results of a mockup review with human subjects, but with less effort and more objective data and analysis. CREW CHIEF is capable of evaluating conceptual designs, identifying problems before expensive hardware is built. Strength values are maximum safe performance for each of the postures modeled.

CREW CHIEF was used in assessing the inspection of an aircraft engine using a boroscope digitized into the CAD system. Analyses were made to evaluate access to the work area for tool reach, and minimum or maximum torque that could be applied on the boroscope plugs, using different extensions and ratchet wrenches, and performed for the 95th percentile male model and the 5th percentile female model.

Knowledge of both the CAD system and the human model is required. Ideally, a team with one CAD user and one human factors engineer is practical.

DOCUMENTATION:
CREW CHIEF has a three-volume users manual. Volume I discusses the interface to the user's CAD system. Volume II discusses the operation of the CREW CHIEF model. Volume III discusses the makeup of the models and techniques for performing workplace accommodation analysis.

McDaniel, J.W. (1997). CAE Tools for Ergonomics Analysis. In Andre, T.S. and Schopper, A.W., Human Factors Engineering in System Design [Chap. 5, pp 100-140], Crew System Ergonomics Information Analysis Center SOAR 97-03, Wright-Patterson AFB, OH.

ALTERNATIVE/COMPARABLE APPROACHES:
Human subjects who may not represent the user population can be evaluated in mockups of the workplace.

STAGE OF DEVELOPMENT:
CREW CHIEF is under continuous product improvement. New data and models are added as available. Requesters get the latest version. Version 5, is currently available. CREW CHIEF has been distributed since 1988. It has been used by the Air Force to evaluate design changes, saving the costs associated with hardware mockups and prototypes.

To obtain, write or 'phone: Crew System Ergonomics Information Analysis Center (CSERIAC) Program Office, AFRL/HEC/CSERIAC, Bldg. 248, 2255 H St., Wright-Patterson AFB, OH 45433-7022, (937) 255-4842 / DSN 785-4842.

VALIDATION:
CREW CHIEF is a system of integrated, interactive models of empirical data, each of which has been validated. The main feature that distinguishes it from other human models is the quality of data modeled, the fact that the models are compatible, and the fact that the models answer the questions asked by workplace designers. CREW CHIEF was developed by the Air Force at a cost of millions of dollars and a research and development effort of more than 14 years. Much of the data modeled, especially the female data, is not available elsewhere.

COMMENTS:
While CSERIAC has a small shipping and handling charge, there is no charge for the CREW CHIEF software itself. Training is available at cost from the developer.

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: Critical Tracking Task (CTT) Software

SPONSOR: Naval Air Warfare Center - Crewstation Technology Laboratory (CTL)
POINT OF CONTACT: Dr Richard S Dunn / 301-342-6076, DSN: 342-6076
EMAIL: dunn@setd-ctl.nawcad.navy.mil
RECORD NO.: HSI00110

GENERAL OVERVIEW:
Software to support CTT methodology was developed by W.P. Gatewood, Jr., R.S. Dunn, and J.F. Antin at the Crewstation Technology Laboratory, NAWCAD, Patuxent River, Maryland. There is a considerable amount of literature on the subject of critical tracking. The CTT is a dynamic tracking task with inherently unstable plan dynamics. The controller must provide some input to maintain the closed-loop stability of the system. The plant dynamics of the task contain a difficulty factor, lambda, which is variable and adjustable under several program control options. Lambda determines the system's momentary instability and thus controls tracking task difficulty. The program has several possible uses, and is very flexible in that several parameters can be adjusted by the experimenter through menu control. Several different configurations can be saved, and test scenarios can be easily developed and executed.

There are two display modes from which to choose - compensatory and pursuit. The control input from the input device can be displayed in either case, and different target movement patterns and rates can also be selected in both display modes. The display can be operated in one or two dimensions. The area of cursor and target movement or error limits in x and y directions can be indicated by an ellipse, or the full screen can be used. The current time in seconds, error, and lambda values can all be displayed on the screen.

Several lambda factors can be selected. These are initial value, initial rate of increase, a second rate of increase, an error threshold which begins the second rate of increase, form of increase (i.e., linear or quadratic), and lambda values - and can be dynamically controlled via error feedback in several different ways. The software can produce fixed, variable, and adaptive or cross-adaptive tasks.

APPROPRIATE USES:
The value of lambda, at which the operator loses control, has been shown to be a reliable measure of operator skill for that particular set of task parameters. This allows for the CTT to be a useful tool in several situations. In a dual-task scenario, the CTT can be used as a loading task, a secondary task, or a primary task. The CTT can be used to classify an operator's psychomotor skills. The CTT software can also drive external displays and provide a method of evaluating alternative display information formats.

EQUIPMENT REQUIRED:
The CTT software is written in the C programming language, and runs on a Silicon Graphics machine. A mouse or a joystick may be used as the input device.

INPUTS REQUIRED:
The operator must set the individual parameters and save them to a set-up file. Several set up files can be placed together to produce a test

scenario. The operator can easily begin a testing session by selecting and running the desired scenario file. Scenario control for the entire test operations is provided by the software.

PROCESSING TECHNIQUES:
The subject's information (RMS error, lambda values, and trial times) is stored in that subject's test file with a full record of system operating information and control input history data.

OUTPUT:
Data files are saved and available for future analysis, as well as for generating a report which summarizes that subject's performance. Included in the report are RMS error, final lambda, and time instability for each trial.

USES OF OUTPUT:
This software supports general purpose CTT methodology in an extremely wide range of potential applications.

DOCUMENTATION:
Jex, Henry R. McDonnell, and Phatak, A.V., "A Critical Tracking Task for Manual Control Research", IEEE Tran., Vol. HFE-7, No.4, Dec. 1966,.pp. 138-145.

ALTERNATIVE/COMPARABLE APPROACHES:
None known.

STAGE OF DEVELOPMENT:
Complete. To obtain, contact W. Pat Gatewood, Jr., Naval Air Warfare Center Aircraft Div., Code 4.6.1.4, MS 3, 48108 Standley Rd., Bldg. 2109, Patuxent R., MD 20670-5304; phone (301) 342-6081; Email, pat@helga@setd-ctl.nawcad.navy.mil

VALIDATION:
The CTT was evaluated at the Crewstation Technology Laboratory, NAWCAD, Patuxent River, MD. A study comparing this digital form to analog versions previously used in manual control research (Jex, McDonnell, and Phatak, 1966) was conducted by J.F. Antin, W.P. Gatewood, Jr., and R.S. Dunn (1990), and referred to as the "Development and Evaluation of Digital Critical Tracking Task". The results showed subject performance was comparable with similar task parameters.

COMMENTS:
In addition to the standard CTT, the program is capable of producing other plant dynamics. These include 0-3rd order, 1st order of exponential lag, and feedback modes in which the task varies in response to scored error performance. The experimenter can also set various gain values and user-selected constant time lags in the input, and plant dynamics computation.

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: Custom Secure Browser

SPONSOR: Wise Web Ware
POINT OF CONTACT: Dr Joel A Goldstein / 910-274-3316
EMAIL: jgoldstn@hotmail.com
RECORD NO.: HSI00172

GENERAL OVERVIEW:
Remotely configures and restricts behavior of users on Web connections; monitors user behavior on Web pages.

APPROPRIATE USES:
Monitoring usage of Websites; maintaining Websites; monitoring and configuring of CBT and CAI; improving and monitoring usage of local intranets.

EQUIPMENT REQUIRED:
PC-compatible or UNIX server

INPUTS REQUIRED:

PROCESSING TECHNIQUES:

OUTPUT:
Improved, configured, and monitored behavior on: 1) Web browser; 2) WWW server; and 3) users' computers.

USES OF OUTPUT:
1) security; 2) configuration; 3) monitoring; 4) CMI

DOCUMENTATION:
Available from: http://www.WiseWebWare.com; or e-mail, telephone, or written request (see addresses and telephone above); with request, manual on Web may be downloaded.

ALTERNATIVE/COMPARABLE APPROACHES:

STAGE OF DEVELOPMENT:

COMMENTS:
Available free to employees of US DoD; available at 35% discount to other US Government civilian employees, State and local government agencies, and defense contractors.

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: Design Evaluation for Personnel, Training, and Human Factors (DEPTH)

SPONSOR: Air Force Research Laboratory
POINT OF CONTACT: Mr John D Ianni / 937-225-1621, DSN: 785-1621
EMAIL: jianni@alhrg.wpafb.af.mil
RECORD NO.: HSI00076

GENERAL OVERVIEW:
When designing or modifying a complex system, it is difficult to mentally "picture" exactly what the end result will be. Only once the costly physical mockup was built were designers able to analyze maintainability. DEPTH addresses this issue by allowing developers to simulate maintenance procedures without physical mockups. CAD models imported into DEPTH are treated as virtual equipment that can be worked on by virtual humans. These "soft" mockups can be modified and reevaluated at a low cost. As the simulations are run, information and animations can be captured for use in logistics analyses and technical multimedia.

APPROPRIATE USES:
Human factors evaluation within a CAD environment; evaluation criteria include strength, reach, fit, error sources, and task time prediction.

EQUIPMENT REQUIRED:
Silicon Graphics workstations

INPUTS REQUIRED:
CAD geometry or product engineering data

PROCESSING TECHNIQUES:
3-D graphic simulation

OUTPUT:
DEPTH is primarily a visualization tool for man-machine design. However, DEPTH demonstrated that simulation results can be transferred to a logistics database. The results of the simulation are also documented in a report, and the simulations can be played back as QuickTime or MPEG movies.

USES OF OUTPUT:
The focus of DEPTH was "design for maintainability". Weapon system designers can watch maintenance activity performed on their virtual mockups originating from CAD. Logistics information, such as manpower, tool, and task time requirements, can be used for maintenence analysis and planning. The animations can be used for training and technical instruction.

DOCUMENTATION:
Boyle, E., "Human Centered Design: Ends and Means," AL-TP-1991-0010, 1991.

Boyle, E., "The Poet: A Future for Human Centered Design," AL-TP-1991-007, 1991.

Ianni, et al., "Maintenance Hazard Simulation: A Study of Contributing Factors," Human Interaction with Complex Systems (HICS) Conference Proceedings, 1996.

Ianni, et al., "DEPTH Final Report," AFRL-HE-WP-TR-1998-0007, 1998.

Vujosevic and Ianni, "A Taxonomy of Motion Models for Simulation of Maintenance Tasks," CALS Expo 1996 Conference Proceedings, 1996.

ALTERNATIVE/COMPARABLE APPROACHES:
Crew Chief, Transom Jack, Safework, among others; see http://www.sae.org/TECHCMTE/g13links.htm for more information on related technologies.

STAGE OF DEVELOPMENT:
The project completed on 12 September 1997, but the technology transfer (to Transom Technologies, Inc.) will not complete until November, 1998. Advanced Development R&D. To obtain, contact the POC.

COMMENTS:
See the Website (www.alhrg.wpafb.af.mil/hess/DEPTH/) for the latest information.

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: Display Visibility Modeling

SPONSOR: NASA Ames Research Center
POINT OF CONTACT: Mr Barry R Smith / 415-604-4264
RECORD NO.: HSI00035

GENERAL OVERVIEW:
The goal of this project, which is a component of MIDAS, is to develop mathematical models of the visibility of cockpit objects imaged on the retina in terms of a visual system footprint. This footprint represents the projection onto the cockpit model of the sensory capabilities of the human visual system when considered as a detector filter system.

APPROPRIATE USES:
The computational methods produced by the SRI-David Sarnoff Research Center will enable crewstation design engineers to perform basic visibility assessments of potential cockpit designs while the designs are in prototype form. This type of model will aid in selecting the appropriate locations for visual characteristics instruments, controls, windows, visors, and sun shields, during the conceptual design phase. This will reduce design costs and enhance the quality of the final product.

EQUIPMENT REQUIRED:
Silicon Graphics 4D Series workstation or Sun Sparcstation.

INPUTS REQUIRED:
Bit-map of image intensity values (monochrome).

PROCESSING TECHNIQUES:
As described in the referenced report, the vision model decomposes input images into successively lower-resolution n-tuples of the original image, based on the photo receptor density mosaic of the human eye. Responses to different image orientations are then accounted for, along with the contrast sensitivity function of the eye. A vector of differences between the two input images is then computed, which is then correlated to the Just Noticeable Difference (JND) quantity. The model can be run on a wide range of stimulus distance, stimulus size, and ambient illumination values to produce "maps" of expected visibility performance.

OUTPUT:
A metric called "Just Noticeable Difference," quantifying a human observer's probability of discriminating differences between any two images. Contours of Iso-JND performance can be developed and superimposed on projected display devices.

USES OF OUTPUT:
The output will allow the designer to visualize the effects of illumination, pilot adaptation, afterimages, head position, and point of regard on the appearance of the instruments as seen by the pilot. Such outputs will aid the crewstation designer in understanding the consequences of their choices for the location, size, and characteristics of cockpit instruments and controls from a human engineering standpoint.

DOCUMENTATION:
Lubin, Jeffrey and James R. Bergen, "Cockpit Display Visibility Modeling," NASA Contractor Report 177623, August 1993.

ALTERNATIVE/COMPARABLE APPROACHES:
None known.

STAGE OF DEVELOPMENT:
Display Visibility Modeling is available now through NASA Cosmic Repository. This model was begun in October 1988, and is currently undergoing further development as part of ARPA's High-Resolution Systems Program.

To obtain additional information, write: Mr. Barry R. Smith, Mail Stop 269-6, NASA-Ames Research Center, Moffett Field, CA 94035-1000.

COMMENTS:
Display Visibility Modeling is one of several components of the MIDAS workstation, developed by the Army-NASA Aircrew/Aircraft Integration program.

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: dVISE

SPONSOR: DIVISION, Inc
POINT OF CONTACT: Mr Nazita Fadakar / 650-312-8100, x516
EMAIL: nazita@division.com
RECORD NO.: HSI00183

GENERAL OVERVIEW:
dVISE allows manufacturers to use their own 3D CAD data to create, visualize, interact with, and analyze a design, effectively studying product form, fit, and function. dVISE can be used to better understand scale and clearances, product functionality, ergonomics, and aesthetics, while improving teamwork and communications. Its simulated human manikin library allows users to study reachability, visibility, and collision-free access.

APPROPRIATE USES:
dVISE can be used to create a digital mockup or prototype to better understand scale and clearances, product functionality, ergonomics, and aesthetics, while improving teamwork and communications.

EQUIPMENT REQUIRED:
Win 95, Win NT, UNIX; Pentium, Sun, HP, SGI platforms; minimum 128 MB RAM; minimum 150 MB hard drive for installation.

INPUTS REQUIRED:
Transfer CAD data through either seamless interfaces for Pro/ENGINEER, UNIGRAPHICS, CV, or through translators for I-DEAS, CATIA, Microstation, etc.

PROCESSING TECHNIQUES:
Once the CAD file has been transferred, the user can either immediately start navigating through the large assembly (sV/Review module of dVISE), or add functionality to the digital mockup to simulate real operating behavior (dV/Reality module of dVISE).

OUTPUT:
The digital mockup can be used just like its physical counterpart. It can be seen, moved, changed, used, tested, shared, and experienced, just like a physical prototype.

USES OF OUTPUT:
Use dVISE to move from just designing part/assembly level to designing at the product level:

Concept and Design Review
- Visualize and flythrough the whole assembly.
- Conduct configuration and trade-off studies to find the optimum design.
- Conduct ergonomics studies on reach, scale, accessibility, visibility, etc.
- Carefully review high-quality aesthetics in realtime, while intractively changing lighting, surface qualities, textures, etc.
- Immerse yourself into your design to better understand its form, fit, and function.
- Quickly analyze collisions and clearances on even the largest of assemblies.
- Cut sections through the Virtual Product for visual inspection of hard-to-see areas.

- Perform regular multi-site design reviews using DesignShare.

Design for Assenbly/Serviceability
- Create optimal paths and sequences for assembly, including the addition of tools and fixtures.
- Visualize the Virtual Product in the context of the whole manufacturing process.
- Study the ease of access for maintenance, and create optimal paths and sequences for disassembly.
- Try out and ensure part clearances among components, allowing for timely, safe, and cost-effective repair.
- Use SmartParts to realistically simulate interaction; determine optimal procedures and operations with parts that behave like real parts.

Training
- Practice complex, expensive, or dangerous procedures with no risk.
- Build interactive training manuals and force sequencing of events in training exercises.
- Simulate trainer/trainee roles by allowing selective access to certain procedures.
- Maximize training retention by immersing the trainee in the environment.

Marketing/Sales
- Run interactive presentations, obtain advance orders, and increase sales by showing new products to customers before the products are actually manufactured.
- Let customers run through the options and make selections in realtime.
- Showcase new products at trade shows by allowing customers to "get in" the product.
- Distribute your Virtual Products to the masses via the Web.

Analyst qualifications:
Design engineer with 3-day training class.

DOCUMENTATION:
dVISE 5.0 documentation available from vendor.

ALTERNATIVE/COMPARABLE APPROACHES:
Creating a physical prototype.

STAGE OF DEVELOPMENT:
Planned upgrades: one major and one minor each year.

VALIDATION:
N/A

COMMENTS:
dVISE 5.0 training available from vendor.

Other vendor locations:

DIVISION, Inc.
5850 Oberlin Dr., Ste. 100B
San Diego, CA 92121
619-597-1060 / FAX -1096
ted@division.com

DIVISION, Inc.

39555 Orchard Hill Pl., Ste. 465
Novi, MI 48375
248-348-1683 / FAX -1751
catherine@division.com
martin@division.com

DIVISION, Inc.
35 Technology Pkwy. S., Ste. 170
Norcross, GA 30092
770-613-5295 / FAX -5282
alan@division.com

DIVISION, Inc.
67 Hartford St.
Natick, MA 01760
508-651-7741 / FAX -7707
sabatini@division.com

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: DYNAMAN

SPONSOR: Air Force Research Laboratory
POINT OF CONTACT: Dr Louise A Obergefell / 937-255-3665, DSN: 785-3665
EMAIL: lobergef@tweety.al.wpafb.af.mil
RECORD NO.: HSI00098

GENERAL OVERVIEW:
DYNAMAN is a complete software simulation package for the prediction of human body dynamics during aircraft ejection, aircraft crashes, automobile accidents, and other hazardous events. It includes a user-friendly preprocessor for developing the database needed for a simulation, the Articulated Total Body (ATB) simulation program, and a post-processor for plotting the simulated body motion and graphing time history results.

APPROPRIATE USES:
Because of its capability to predict the motion and forces on the human body, manikins, seats, and other structures, the DYNAMAN model has broad applications in the automobile, aerospace and other transportation systems communities. It is used in the Air Force to determine the safety of restraint systems, seats, escape systems, controls and displays, and other equipment in the aircraft cockpit before prototypes are built or costly tests conducted. It is also used to provide data that cannot be measured during a test, such as forces within the body, and to supplement test data with parameter variation simulations.

EQUIPMENT REQUIRED:
DYNAMAN runs on 386 or higher DOS-based personal computers.

INPUTS REQUIRED:
The preprocessor input requirements for a simulation include a description of the human or dummy body, the environment, the driving motion or force, and the initial conditions. The body data can be obtained using a preprocessing module based on Generator of Body Data (GEBOD), which calculates the required data for adult males, adult females, children, or testing dummies.

PROCESSING TECHNIQUES:
The input is processing by the simulation model. This ATB simulation model uses the three-dimensional forms of Newton's Second Law and Euler's Equation as the equations of motion for each body segment, and Lagrange-type equations to apply the joint constraints. Constitutive equations are used to model body interactions with restraints belts, air bags, gravity, wind, and surrounding surfaces represented by planes and ellipsoids.

OUTPUT:
The post-processor provides plots and tables of a wide range range of time histories, including segment linear and angular positions, velocities, and accelerations; joint angles, forces, and torques; body center of mass location, momentum, and kinetic energy; and contact, belt, and aerodynamic forces. It also depicts the body and its environment at any time step with line drawings allowing the user to interactively adjust viewing angles and drawing options.

USES OF OUTPUT:
The simulation results can be used to determine equipment clearances, to

estimate injury, and to investigate body motion and safety. Postprocessor output can also be captured for importation into spreadsheet, wordprocessor, or graphics programs.

DOCUMENTATION:
Shams, T., Weerappuli, D., Sharma, D., Nurse, R., Rangarajan, N., "DYNAMAN User's Manual, Version 3.0," Armstrong Laboratory Report No. AL/CF-TR-1993-0076, Wright-Patterson Air Force Base, OH, December 1992.

ALTERNATIVE/COMPARABLE APPROACHES:
The ATB model is available separately and can be run on a wider variety of computers. Dynamic models with features similar to DYNAMAN include MADYMO developed by TNO in the Netherlands, and MVMA3D by the Motor Vehicle Manufacturers Association.

STAGE OF DEVELOPMENT:
Developed by GESAC, Inc., under a Small Business Innovative Research (SBIR) contract. Complete and operable version delivered in 1992. GESAC is continuing development.

To obtain information write to:

Dr. Louise Obergefell
AL/CFBV
2610 Seventh St.
Wright-Patterson Air Force Base, OH 45433-7901

VALIDATION:
Modifications to simulation model are validated in:
Weerappuli, D., Shams, T., Sharma, D., and Rangarajan, N., "DYNAMAN Theoretical Manual Version 3.0," Armstrong Laboratory Report No. AL-TR-1992-0185, Wright-Patterson AFB, OH, December 1992.

COMMENTS:
None.

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: Expert System for Test Program Set Quality Assurance (ESQA)

SPONSOR: Prospective Computer Analysts, Inc
POINT OF CONTACT: VP Greg Winter / 516-742-9100
EMAIL: gregwinter@worldnet.att.net
RECORD NO.: HSI00138

GENERAL OVERVIEW:
ESQA is an expert system that automatically analyzes Test Program Source code for quality metrics. ESQA generates 23 quality reports. ESQA is available to government agencies and/or commercial businesses.

APPROPRIATE USES:
Development and Procurement of Test Programs.

EQUIPMENT REQUIRED:
486DX or better / 4MB RAM (8MB recommended) / 8MB Hard Disk space / Windows or Windows 95.

INPUT REQUIRED:
Test Program Source Code in ASCII format.

PROCESSING TECHNIQUES:
ESQA extracts data from the Test Program source code using a front-end parser, written in C++, which processes the code like a compiler. The extracted data is then input to a Microsoft Access database. A Graphic User Interface (GUI) and various functions in Visual Basis are used to process the data, and Crystal Reports is used to format and output the final reports.

OUTPUTS:
23 quality reports, including Fault Isolation Percentage, TPS structure analyses, test efficiency, test accuracy and many others.

USES OF OUTPUT:
Now used by U.S. Navy to analyze Test Programs. Also used in the Test Program acceptance process. May be used by any organization to rapidly review and manage Test Program development efforts.

DOCUMENTATION:
Full-color user's manual and online help functions.

ALTERNATIVE/COMPARABLE APPROACHES:
There is no other comparable product currently available. The only other approach is to manually analyze code.

STAGE OF DEVELOPMENT:
A fully mature product in development since 1991. Release version 4.0 provided to all users in May 1996. Represents the state of the art in Test Program automated analyses.

VALIDATION:
Validated under a report developed under contract N68335-92-D-0226, D.O.-007, "Quality Assurance Analysis of F14D WRA OTPS Software, an OP-EVAL Report Evaluation Project 778-OT-IIIA"

COMMENTS:
ESQA has been used on more than 500 Navy, Air Force, Army and commercial TPSs. ESQA is installed at 9 DoD and numerous commercial sites.
ESQA was developed under the Small Business Innovation Research Program (SBIR).

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: Generator of Body Data (GEBOD)

SPONSOR: Air Force Research Laboratory
POINT OF CONTACT: Dr Louise A Obergefell / 937-255-3665, DSN: 785-3665
EMAIL: lobergef@tweety.al.wpafb.af.mil
RECORD NO.: HSI00096

GENERAL OVERVIEW:
The GEBOD program provides the data needed by the Articulated Total Body (ATB) model to describe the human or manikin occupant.

GEBOD will generate the body segment and joint properties for any size male or female based on their height and weight. It will also provide child data based on age, height, and weight.

APPROPRIATE USES:
GEBOD was designed specifically to provide the body data needed by the ATB program for human body dynamic simulations. The data provided can be used by other similar programs and in applications where the body link and mass properties are needed.

EQUIPMENT REQUIRED:
The GEBOD program was written in FORTRAN77. It runs on most computers with a FORTRAN compiler, including personal computers, workstations, and mainframes.

INPUTS REQUIRED:
GEBOD is an interactive program, asking several basic questions about the body to be generated, such as gender, height, and weight.

PROCESSING TECHNIQUES:
Regression equations based on height and weight are used to calculate the body data for adult males, adult females, and children for these data sets. The regression equations have been developed from anthropometric surveys and stereophotometric data.

OUTPUT:
GEBOD creates a model consisting of fifteen or seventeen links connected in a tree structure representing the human or manikin body. The body is provided in two files: a report file containing a list of the human body dimensions and labeled tables containing the body data, and an input file formatted for the ATB program. The body data sets include the body segments' geometric and mass properties, and the joint's locations and mechanical properties.

USES OF OUTPUT:
The output data file generated by GEBOD can be inserted directly into an ATB input file.

DOCUMENTATION:
Cheng, H., Obergefell, L., and Rizer, A., "Generator of Body Data (GEBOD) Manual," Armstrong Laboratory Report No. AL/CF-TR-1994-0051, Wright-Patterson Air Force Base OH, March 1994.

ALTERNATIVE/COMPARABLE APPROACHES:
None.

STAGE OF DEVELOPMENT:
Complete and operable with revisions released periodically.
Write: Dr. Louise Obergefell
AL/CFBV
2610 Seventh St.
Wright-Patterson Air Force Base, OH 45433-7901

VALIDATION:
Validation of the Hybrid II and Hybrid III dummy datasets generated by GEBOD is documented in:

Obergefell, L.A., Kaleps, I., and Steele, S., "Part 572 and Hybrid III Dummy Comparison Sled Test Simulations," SAE Paper No. 880639, February 1988.

COMMENTS:
None.

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: GS-Design

SPONSOR: Graphic Systems Corporation
POINT OF CONTACT: Mr Michael A Dincau / 818-565-5680
EMAIL: mike@graphic-systems.com
RECORD NO.: HSI00019

GENERAL OVERVIEW:
The GS-Design system is a geometry modeling system which can be used for complete design projects, from three-dimensional layouts to solid modeling of individual parts. Parts of any complexity can be modeled as topologically closed (solid) objects. GS-Design supports both manifold and non-manifold part models. Parts are designed in a virtually unlimited assembly context that provides the designer with unprecedented design visibility. Part and Assembly models are used to produce drawings in a highly automated way. GS-Design provides serialized configuration control of assemblies of any complexity. GS-Design uses an SQL-compatible relational database to maintain the interrelationship of all design and manufacturing data.

APPROPRIATE USES:
GS-Design has been used on major aircraft development programs, and can be used to support the most demanding of design development projects typically found in the transportation industry. However, this is a very generalized design development tool that would be appropriate wherever time-to-market and development costs are important. The more complex the design task, the greater the benefit. The system supports network processing, and has been used in a nationwide networked design project.

EQUIPMENT REQUIRED:
GS-Design operates in a client server architecture. The servers run under the HP-UX operating system, and the clients will run under either the HP-UX or Windows operating systems.

INPUTS REQUIRED:
Inputs are made via the computer keyboard, mouse, and keypad to interact with GS-Design to develop parts and systems, or with IGES input files.

PROCESSING TECHNIQUES:
The GS-Design system uses PCs or workstations networked to a relational database server.

OUTPUT:
The GS-Design output consists of multicolor 3-D graphic imagery, dimensioned drawings, IGES geometry files, and NC machine control data.

USES OF OUTPUT:
The GS-Design system output can be used for direct input to the manufacturing process.

DOCUMENTATION:
This system was used in the design of parts of the Advanced Tactical Fighter prototype and the P-7A Anti-Submarine Warfare aircraft, in addition to other programs.

ALTERNATIVE/COMPARABLE APPROACHES:
Other CAD systems and lots of time.

STAGE OF DEVELOPMENT:
Production system has been completed and enhancements continue. The system is available over the Internet as a service.

To obtain, contact the POC.

COMMENTS:
Easy to operate, very fast, self-sustaining, and self-paced in a comfortable size and color.

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: HSI/MANPRINT Integrated Decision/Engineering Aid (IDEA) Tools

SPONSOR: Carlow International, Inc
POINT OF CONTACT: Dr Thomas B Malone / 703-698-6225
EMAIL: tbmalone@carlow.com
RECORD NO.: HSI00144

GENERAL OVERVIEW:

The HSI/MANPRINT Integrated Decision/Engineering Aid (IDEA) tool set is a set of automated processes, tools, and databases developed specifically to enable HSI/MANPRINT analysts in the Army and Navy to meet the requirements of the DoD 5000 series documents, as well as Service-specific regulations and directives (Army Regulation 602-2; Naval Sea Systems Command Instruction 3900.8). The guiding principle behind the design of the IDEA software is that the HSI/MANPRINT analyst should have at his or her fingertips all of the guidance, instructions, processes, procedures, methods, tools, and data needed to conduct a timely and complete HSI/MANPRINT effort. The elements of the IDEA system are: the HFE/MANPRINT process; an integrated HFE/MANPRINT information system; automated HFE/MANPRINT tools; and a report generator for producing HFE/MANPRINT plans and reports. IDEA automated HFE/MANPRINT tools include:

a) an IDEA HSI Process Tool
b) a Comparability Analysis (I-CAN) tool which supports the identification of high-driver tasks/conditions and lessons learned from predecessor systems
c) a Role-of-the-Person (ROPER) tool which supports function allocations and determination of alternate feasible roles of the human
d) a Task Analysis (I-TASK) tool based on MIL-H-46855 and MIL-STD-1478
e) a functional flow/task sequencing tool, designated NETWORK, for graphically establishing the relationships among functions and tasks
f) a Simulation for Workload Assessment and Modeling (SIMWAM) tool for assessing multi-operator task network impacts on human performance and workload
g) a Tradeoff Analysis (ITALIC) tool to support the evaluation of alternative approaches, and assessment of alternatives on each criterion measure
h) a Safety and Health Hazard Analysis Determination and Evaluation (I-SHADE) tool to identify and track hazards, and develop hazard resolution plans
i) a Human Factors Engineering Data Guide for Evaluation (I-HEDGE) tool to support the selection, evaluation, and production of design checklists
j) an HSI Planning (I-PLAN) tool which supports planning an HSI or MANPRINT effort by tracking project tasks, personnel hours, task status, and deliverables with due dates
k) Carlow's Usability Test Tool for Evaluation and Research (CUTTER), which offers the following three modules to support all phases of usability testing: 1) a test preparation and planning support module; 2) a data-logging and data analysis module; and 3) an interface evaluation guideline module
l) a hypertext version of MIL-STD-1472D

APPROPRIATE USES:
The tool has application throughout the system design process. In the front-end conceptual design phase, the IDEA tool addresses: 1) analysis and integration of requirements, from mission requirements, through function

requirements, to task performance requirements; 2) allocation of function and determination of the role of the human vs. automation in performance of system functions; 3) development of alternate concepts for human-system interaction; 4) conduct of task network simulation to assess workload and human performance requirements for alternative design concepts, and identification of manning levels associated with each concept; and 5) assessment of the affordability and risk potential associated with each design approach. In the demonstration and validation phase, the IDEA tool is directed toward developing design requirements and prototyping and assessing alternate human-machine interface (HMI) approaches and strategies. In the engineering and manufacturing development phase, the IDEA focus is in design and evaluation of HMI elements.

EQUIPMENT REQUIRED:
The IDEA suite of tools runs on Macintosh and is currently being ported to Windows. See individual tool descriptions (this Section) to see the status of the translation.

INPUTS REQUIRED:
Inputs to an HFE analysis and design effort. For specific inputs, refer to the descriptions of the individual tools (this Section) that form IDEA.

PROCESSING TECHNIQUES:
Processes and tools are written in HyperCard for Macintosh, and Tool Book for Windows. For specific processing techniques, refer to the descriptions of the individual tools (this Section) that form IDEA.

OUTPUT:
Generated reports. For specific outputs, refer to the descriptions of the individual tools (this Section) that form IDEA.

USES OF OUTPUT:
In conceptual design, the output includes results of mission and function analysis, roles of humans vs. automation, and required manning levels for the system. These outputs are used to specify the level of automation, required roles of the human and requirements to support these roles, and numbers and qualifications of personnel to man the system. In the demonstration and validation phase, outputs are used to further define the roles and requirements of human performance, particularly as it interacts with automated performance. In the engineering and manufacturing development phase, outputs include design criteria and specifications for human-machine interfaces, training systems, user documentation, information systems, and system safety design requirements.

DOCUMENTATION:
Each tool in the IDEA tool set has a corresponding user's guide.

ALTERNATIVE/COMPARABLE APPROACHES:
There is no tool set comparable to the IDEA tool set. However, there are alternatives to individual IDEA tools, such as Micro-Saint simulation tool, which performs some of the functions of SIMWAM, and several task analysis tools which are comparable to I-TASK.

STAGE OF DEVELOPMENT:
See the individual tool descriptions (this Section).

VALIDATION:
Validated at ARL(HRED) Field Centers, UK MANPRINT Office, French Army's L'Etablissement Technique D'Angers (ETAS), Netherlands Org. for Applied

Scientific Research, Institute for Perception, British Aerospace, Bristol, UK, Rediffusion Simulation, Ltd., Crawley, UK, Singapore Automotive Engineering Ltd., and in the Naval Sea Systems Command's Total Ship Survivability Program.

COMMENTS:
Following is a list of publications describing the IDEA tool set and specific applications:

Heasly, C.C. and Malone, T.B. (1992). "Integrated Decision/Engineering Aid (IDEA) - Enhancements", Proceedings of the 36th Annual Meeting of the Human Factors and Ergonomics Society, Atlanta, GA.

Heasly, C.C. and Malone, T.B. (1993). "Integrated Decision/Engineering Aid (IDEA) - Enhancements", Proceedings of the 37th Annual Meeting of the Human Factors and Ergonomics Society, Seattle, WA.

Heasly, C.C., Malone, T.B., and Hayes, T.J. (1991). "Industrial Application of NETWORK/SIMWAM to Medical Assembly Processes", Proceedings of the International Ergonomics Association's Annual Meeting, Paris, France.

Heasley, C.C., Permenter, K.E., Malone, T.B., Baker, C.C., and Lawrence, L.G. (1988). "Determination of MANPRINT Program Initiation Requirements for the Lighter, Amphibious, Heavy Lift (LAMP-H)", Proceedings of the 32nd Annual Meeting of the Human Factors Society, Anaheim, CA.

Heasly, C.C., Perse, R.M., and Malone, T.B. (1988). "MANPRINT in the Program Initiation Phase of System Acquisition", Proceedings of the 32nd Annual Meeting of the Human Factors Society, Anaheim, CA.

Kirkpatrick, M., Malone, T.B., Heasly, C.C., and Baker, C.C. (1990). "Manpower, Personnel, Training and Safety (MPTS) Simulation Tools: NETWORK and Simulation for Workload Assessment and Modeling (SIMWAM)", Proceedings of the 34th Annual Meeting of the Human Factors Society, Orlando, FL.

Malone, T.B., Baker, C.C., and Oberman, F. (1992). "Reverse Engineering Allocation of Function Requirements Analysis (REARM)", 28th meeting of the DoD Human Factors Engineering Technical Group.

Malone, T.B. (1989). "MPTS Methodology in the Navy: Enhanced HARDMAN", Proceedings of the 33rd Ann. Meeting of the Human Factors Soc. Denver, CO.

Malone, T.B. and Baker, C.C. (1988). "Human Factors for Naval Systems: Enhanced HARDMAN", Proceedings of the 32nd Annual Meeting of the Human Factors Society, Anaheim, CA.

Malone, T.B. and Heasly, C.C. (1991). "The U.S. Army's HFE/MANPRINT IDEA (Integrated Decision/Engineering Aid)", Proceedings of the 35th Annual Meeting of the Human Factors Society, San Francisco, CA.

Malone, T.B., Eike, D.R., Kirkpatrick, M., Heasly, C.C., and Westerman, D.P. (1989). "Integrated Decision/Engineering Aid (IDEA)", Proceedings of the 33rd Annual Meeting of the Human Factors Society, Denver, CO.

Malone, T.B., Heasly, C.C., and Eike, D.R. (1990). "The Army MANPRINT IDEA (Integrated Decision/Engineering Aid)", Proceedings of the 34th Annual Meeting of the Human Factors Society, Orlando, FL.

Malone, T.B., Heasly, C.C., and Baker, C.C. (1994). "Reverse Engineering Allocation of Functions Methodology for Reduced Manning", NATO Conference on Function Allocation.

Malone, T.B., Heasly, C.C., and Vingelis, P.J. (1991). "The HFE/MANPRINT Integrated Decision/Engineering Aid - IDEA", Proceedings of the International Ergonomics Association's Annual Meeting, Paris, France.

Malone, T.B., Heasly, C.C., Kirkpatrick, M., and Welch, D.L. (1993). "Human Factors Automated Methods and Tools", First Annual Meeting, Ergonomics in Russia, the Other Independent States, and Around the World, Russian Ergonomics Association and Polish Ergonomics Soc., St. Petersburg, Russia.

Malone, T.B., Heasly, C.C., Kirkpatrick, M., Perse, R.M., Vingelis, P.J., and Welch, D.L. (1992). "Human Systems Integration (HSI) and MANPRINT Requirements and Tools", Proceedings of the 36th Ann. Meeting of the Human

Factors and Ergonomics Society, Atlanta, GA.
Norman, D.L. and Malone, T.B. (1992). "A Better IDEA: Human Systems Integration (HSI) Methods and Tools", Proceedings of the 14th Interservice/Industry Training Systems and Education Conference, San Antonio, TX.

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: Hybridizer

SPONSOR: Wise Web Ware
POINT OF CONTACT: Dr Joel A Goldstein / 910-274-3316
EMAIL: jgoldstn@hotmail.com
RECORD NO.: HSI00171

GENERAL OVERVIEW:
A tool to catalog, deliver, and monitor multimedia files.

APPROPRIATE USES:
Tracking multimedia files for training, manuals, reference materials.

EQUIPMENT REQUIRED:
PC-based or UNIX-based network

INPUTS REQUIRED:
Network directories

PROCESSING TECHNIQUES:

OUTPUT:
Listing of multimedia files; delivery of multimedia files; monitoring delivery of multimedia files.

USES OF OUTPUT:
Cataloging, delivery, and monitoring of file usage.

DOCUMENTATION:
Available from: http://www.WiseWebWare.com; or e-mail, telephone, or written request (see addresses and telephone above).

ALTERNATIVE/COMPARABLE APPROACHES:

STAGE OF DEVELOPMENT:

COMMENTS:
Available free to employees of US DoD; available at 35% discount to other US Government civilian employees, State and local government agencies, and defense contractors.

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: IDEA Human Systems Integration (HSI) Process Tool

SPONSOR: Carlow International, Inc
POINT OF CONTACT: Dr Thomas B Malone / 703-698-6225
EMAIL: tbmalone@carlow.com
RECORD NO.: HSI00146

GENERAL OVERVIEW:
The IDEA Human Systems Integration (HSI) Process Tool is a graphic presentation of the activities associated with applying HSI/MANPRINT at each phase of system acquisition. The IDEA HSI/MANPRINT process architecture has the following characteristics:

- it is integrated with the activities, products, and requirements for each phase of the system acquisition process
- it defines and describes HSI/MANPRINT activities, events, inputs/outputs, products, and methods for each system acquisition process phase, and provides guidelines on the application of the activities and methods, and on the contents and format of the products
- it provides a help facility to further assist the analyst in tailoring the process to the specific system under acquisition
- it incorporates the tools required to apply the HSI methods, and to accomplish the HSI/MANPRINT activities, and provides access to any tool from any point in the process
- it is focused on personnel readiness and effectiveness requirements
- it addresses the development of a new system, a non-development item (NDI), or product improvement
- it provides a formal mechanism for getting HSI/MANPRINT issues and concerns addressed early in system acquisition.

The process currently consists of 64 individual HSI/MANPRINT steps over the 6 phases of system acquisition, at up to 5 levels of decomposition.

APPROPRIATE USES:
The process comprises the basis for HSI/MANPRINT planning activities, identification and tracking of HSI/MANPRINT issues, conduct of individual HSI/MANPRINT activities, and application of IDEA tools. A French language version of the process also exists.

EQUIPMENT REQUIRED:
The process is a Hypertext graphic written in HyperCard for the Apple(r) Macintosh or IBM PC compatibles. Macintosh version requires System 6.0 or higher, and HyperCard 2.1 or later. PC version requires Windows 3.1 or higher, and Tool Book for Windows.

INPUTS REQUIRED:
Requirements to tailor the standard IDEA process to the specific system acquisition.

PROCESSING TECHNIQUES:
Inherent in HyperCard and Tool Book.

OUTPUT:
Notes generated in a Notes facility which enables tailoring of the process steps and input of data for the system under analysis.

USES OF OUTPUT:

Products of specific HSI activities.

DOCUMENTATION:
IDEA Human Systems Integration (HSI) Process Tool User's Guide.

ALTERNATIVE/COMPARABLE APPROACHES:
The HSI Process Tool resident in the SHIPSHAPE tool set.

STAGE OF DEVELOPMENT:
Completed and fully operational in HyperCard and Tool Book, and will be ported to HTML for the Web.

VALIDATION:
Validated at HRED Field Centers, UK MANPRINT Office, French Army's L'Etablissement Technique D'Angers (ETAS), Netherlands Org. for Applied Scientific Research - Institute for Perception, British Aerospace, Bristol, UK, Rediffusion Simulation Ltd., Crawley, UK, Singapore Automotive Engineering Ltd., and in the Naval Sea Systems Command's Total Ship Survivability Program.

COMMENTS:
The IDEA Process is in HyperCard, which enables determination of requirements and guidelines for performing each process step at several levels of detail. The process tool enables generation of products for the specific application through a Note Book facility which allows the analyst to input or import data directly to the appropriate section of the process.

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: IDEA Hypertext Tool for MIL-STD-1472 (HT-1472)

SPONSOR: Carlow International, Inc
POINT OF CONTACT: Dr Thomas B Malone / 703-698-6225
EMAIL: tbmalone@carlow.com
RECORD NO.: HSI00142

GENERAL OVERVIEW:
The IDEA Hypertext Tool for MIL-STD-1472 (HT-1472) evolved from a demonstrated need to quickly locate and extract specific items of information from MIL-STD-1472, entitled "Human Engineering Design Criteria for Military Systems, Equipment and Facilities." The objective of the tool is to assist an analyst in quickly and accurately identifying and accessing required sections or criteria of MIL-STD-1472. There are six main parts to HT-1472: 1) the Index Screen, 2) the Context Screen, 3) the Text Screen, 4) Figures, 5) Tables, and 6) Notes. The Index Screen contains two methods for accessing the content of MIL-STD-1472 - an index and a table of contents. The index contains every word in MIL-STD-1472 in alphabetical order with the number of occurrences of the word next to it. The analyst uses the scroll bar or the UP and Down cursor keys to scroll through the index. As an alternative, the user can click on the "?" box in the middle of the scroll bar to quickly jump to a specific word, or can click on a word in the index to display every occurrence of that word in context (i.e., with 10 or 15 of the surrounding words). The table of Contents is a duplicate of the Table of Contents contained in MIL-STD-1472. The Table of Contents is scrollable, and any item can be selected to display the corresponding section of MIL-STD-1472.

APPROPRIATE USES:
Design documentation, 1472 look-up, and derivation of test and evaluation criteria.

EQUIPMENT REQUIRED:
- Apple(r) Macintosh running System 6.0 or higher
- HyperCard 2.1 or later

INPUTS REQUIRED:
Requirement to access 1472 criteria.

PROCESSING TECHNIQUES:
Resident in HyperCard.

OUTPUT:
Word processing document containing sections cut-and-pasted from 1472.

USES OF OUTPUT:
Uses of 1472 data.

DOCUMENTATION:
IDEA Hypertext Tool for MIL-STD-1472 (HT-1472) User's Guide.

ALTERNATIVE/COMPARABLE APPROACHES:

STAGE OF DEVELOPMENT:
Completed.

VALIDATION:
Validated at HRED Field Centers, UK MANPRINT Office, French Army's L'Etablissement Technique D'Angers (ETAS), Netherlands Org. for Applied Scientific Research - Institute for Perception, British Aerospace, Bristol, UK, Rediffusion Simulation Ltd., Crawley, UK, Singapore Automotive Engineering Ltd., and in the Naval Sea Systems Command's Total Ship Survivability Program.

COMMENTS:

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: IDEA/SHIPSHAPE Comparability Analysis (I-CAN)

SPONSOR: Carlow International, Inc
POINT OF CONTACT: Mr Clifford C Baker / 703-698-6225
EMAIL: cliffbaker@carlow.com
RECORD NO.: HSI00147

GENERAL OVERVIEW:
The IDEA/SHIPSHAPE Comparability Analysis (I-CAN) tool, used in the IDEA and SHIPSHAPE tool sets, was developed to aid Combat Developers (CD) in influencing system design by introducing Manpower (M), Personnel (P), and Training (T) constraints and guidelines in the early developmental phases of the acquisition process. Identifying and addressing significant human-machine interface constraints and concerns during the early phases of the design process is far more cost-effective, efficient, timely and safe than modifying a fielded system. I-CAN uses a lessons learned approach to system design; therefore, it requires a predecessor and/or reference system. The primary objectives of I-CAN involve:

1) establishing soldier task constraints as a basis for system development
2) identifying predecessor or reference system high drivers
3) limiting or eliminating high drivers in the developing system, by addressing MPT issues early in the planning and decision-making process.

APPROPRIATE USES:
I-CAN is a cost-effective methodology for identifying task(s) that have a likelihood of significantly impacting operational effectiveness. The approach utilizes subject matter experts to identify "high-driver tasks" in the Manpower, Personnel, Training, Safety, Health and Human Factors engineer. I-CAN products can provide alternative materiel decisions, and can influence design and product supportability throughout the HFE/MANPRINT process.

EQUIPMENT REQUIRED:
- Apple(r) Macintosh running System 6.0 or higher. HyperCard 2.1 or later. Minimum of 8 megabytes of RAM, 3 megabytes of hard disc drive space.
- IBM PC or clone running Windows 3.X and Windows 95. Minimum of 8 megabytes of RAM, 3 megabytes of hard disc drive space.

INPUTS REQUIRED:
Questions for Subject Matter Experts (SME):

1. What proportion of the relevant MOS and skill level perform this task?
2. How difficult is it for the average soldier to learn this task?
3. How difficult is it physically for the average soldier to perform this task?
4. How difficult is it mentally for the average soldier to perform this task?
5. On the average, how often is this task conducted?
6. How much task proficiency is lost by the average soldier between formal training and the first attempt to complete the task in the field?
7. How much time is required to train the average soldier to perform this task to standard?
8. How hazardous is this task?
9. Are any special skills required to successfully complete this task?
10. Estimate the error frequency associated with completing this task.

The I-CAN tool can utilize data from the following tools: I-TASK and NETWORK.

PROCESSING TECHNIQUES:
Compilation of ratings to standard assessment categories by subject matter experts.

OUTPUT:
I-CAN is a cost-effective methodology for identifying task(s) that have a likelihood of significantly impacting operational effectiveness. The approach utilizes subject matter experts to identify "high-driver tasks" in the Manpower, Personnel, Training, Safety, Health and Human Factors Engineering domains.

I-CAN can also be utilized as a data source for I-TASK task inventories.

USES OF OUTPUT:
The cost of conducting an early comparability analysis is reduced because of the automation features integrated into I-CAN. As with other IDEA tools, analyses are more cohesive because the underlying data are consistent. The data are more accessible because of the search/retrieval and publishing features contained within I-CAN.

DOCUMENTATION:
IDEA/SHIPSHAPE Comparability Analysis (I-CAN) Tool User's Guide.

ALTERNATIVE/COMPARABLE APPROACHES:

STAGE OF DEVELOPMENT:
Complete.

VALIDATION:
Statistical/computational modules validated analytically. Database, data logging, and reporting modules validated analytically. Planning modules validated subjectively.

COMMENTS:
The major applications of the I-CAN tool are to identify lessons learned from existing systems, and to identify high-driver functions and conditions from an HSI point of view.

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: IDEA/SHIPSHAPE Human Factors Engineering Data Guide for Evaluation (I-HEDGE)

SPONSOR: Carlow International, Inc
POINT OF CONTACT: Dr Mark Kirkpatrick / 703-208-3453
EMAIL: mkirkpatrick@carlow.com
RECORD NO.: HSI00154

GENERAL OVERVIEW:
The IDEA/SHIPSHAPE Human Factors Engineering Data Guide for Evaluation (I-HEDGE) tool, developed for both the IDEA and SHIPSHAPE tool sets, is an automated methodology for selecting design test criteria from the Human Factors Engineering Data Guide for Evaluation (HEDGE), Part II of Test Operating Procedure (TOP) 1-2-610. This constitutes Step 6.2 of the TOP 1-2-610 "Steps in Preparation for an HFE Test."

I-HEDGE is a Filemaker Pro template and user interface, which aids in the selection, evaluation, and hardcopy production of HEDGE Design Checklists. The following checklists are available in I-HEDGE:

1. Labels, Manuals & Markings
2. Steps, Ladders, Platforms, Handholds & Railings
3. Doors, Hatches & Passages
4. External Components
5. Controls
6. Special Controls
7. Displays
8. Special Displays
9. Communications
10. Lines, Hoses & Cables
11. Workspace
12. Fasteners
13. Handles
14. Optics
15. Operating Elements
16. Packaging
17. Accesses, Covers & Caps
18. Measures
19. Replaceable Units
20. Test Elements & Tools
21. Clothing & Personal Equipment
22. Structural Components

APPROPRIATE USES:
I-HEDGE permits rapid and efficient selection and tailoring of design checklists, and prints them in TECOM standard format. In addition, I-HEDGE provides the capabilities of a powerful database management system to permit the user to store the results of checklist evaluations, and sub-select, sort, and produce reports based on all fields.

EQUIPMENT REQUIRED:
Win 3.1x, Win 95, Mac OS on any CPU; minimum 3 MB RAM; Claris Corp. FileMaker Pro

INPUTS REQUIRED:
Response to checklist item, indicating whether the test item design is in compliance with the checklist item. Comments describing non-compliance.

I-HEDGE contains a master database of all HEDGE checklist items. The user selects those items that are applicable to the test item, and creates tailored checklists for the test in question. Using a laptop computer, responses to checklist items can be entered as the test proceeds, or paper checklists can be printed and used during the test.

PROCESSING TECHNIQUES:
I-HEDGE permits the user to store the results of checklist evaluations, and sub-select, sort, and produce reports based on all fields.

OUTPUT:
I-HEDGE can print standard format hardcopy of the tailored design checklists for use in a normal, manual manner. Alternatively, I-HEDGE can be used as an electronic checklist, itself, during HFE Test and Evaluation.

USES OF OUTPUT:
HFE test and evaluation.

Bachelors or Masters degree in Human Factors, 2-5 years HFE experience, 1 hour of training on tool, familiarity with HEDGE and MIL-STD-1472.

DOCUMENTATION:
IDEA/SHIPSHAPE Human Factors Engineering Data Guide for Evaluation (I-HEDGE) Tool User's Guide.

ALTERNATIVE/COMPARABLE APPROACHES:
Photocopying checklists from the HEDGE document, and using these paper products for data collection.

STAGE OF DEVELOPMENT:
Completed.

VALIDATION:
The tool was validated in several test and evaluation efforts conducted for the U.S. Army Test and Evaluation Command (TECOM):

Kirkpatrick, M. and Malone, T.B. (1990), "Development of Automated Tools and Techniques for Army Human Factors Engineering Test and Evaluation", U.S. Army Test and Evaluation Command.

Malone, T.B. (1996), "Human Factors Test Support Documentation", in O'Brien and Charlton, Eds., Handbook of Human Factors Test and Evaluation, Erlbaum Associates.

COMMENTS:

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: IDEA/SHIPSHAPE Human Systems Integration Planning (I-PLAN)

SPONSOR: Carlow International, Inc
POINT OF CONTACT: Dr Mark Kirkpatrick / 703-208-3453
EMAIL: mkirkpatrick@carlow.com
RECORD NO.: HSI00155

GENERAL OVERVIEW:
The IDEA/SHIPSHAPE Human Systems Integration Planning (I-PLAN) tool, developed for both the IDEA and SHIPSHAPE tool sets, supports planning an HSI or MANPRINT effort. Project tasks are entered and can be deleted. Within each task, the user can allocate personnel hours, define task start and end dates in calendar months or project months (1,2,3...), and track task status, deliverables with due dates, and other aspects of a project schedule. The software aggregates total hours per person assigned to the project, and can export files, including project plan and periodic status reports that can be opened under a spreadsheet application.

The planning tool also enables an evaluation of an HSI Plan. In this evaluation, the plan is assessed in terms of its completeness, accuracy, feasibility, quality, consistency, compliance, and timeliness.

APPROPRIATE USES:
Planninmg a MANPRINT or HSI project.

EQUIPMENT REQUIRED:
- Apple(r) Macintosh running System 7.0 or higher
- Filemaker Pro(tm)

INPUTS REQUIRED:
Personnel names, project tasks, start and completion dates, task and deliverable status, hours assigned by task and person.

PROCESSING TECHNIQUES:
Spreadsheet allocation of hours to tasks.

OUTPUT:
Project plan document, status reports, tables of hours by person and task, and by person and project month.

USES OF OUTPUT:
Project planning, monitoring and management.

DOCUMENTATION:
IDEA/SHIPSHAPE Human Systems Integration Planning (I-PLAN) Tool User's Guide.

ALTERNATIVE/COMPARABLE APPROACHES:
Commercially available project planners.

STAGE OF DEVELOPMENT:
Completed.

COMMENTS:

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: IDEA/SHIPSHAPE Role of the Person (ROPER) Function Allocation Tool

SPONSOR: Carlow International, Inc
POINT OF CONTACT: Mr Clifford C Baker / 703-698-6225
EMAIL: cliffbaker@carlow.com
RECORD NO.: HSI00148

GENERAL OVERVIEW:
The IDEA/SHIPSHAPE Role of the Person (ROPER) Function Allocation Tool is used in both the IDEA and SHIPSHAPE tool sets. It address a detailed comparative evaluation of human vs. machine functional allocation (iterated for each/all concept(s)). The ROPER tool is used to develop/evaluate function allocations between humans and automation. Based on trade-off criteria and relative importance weights, the tool conducts trade-offs of alternative allocation strategies based on the most effective, efficient, economical, and safe utilization of crew members, and provides guidelines on the strong and weak points of alternative allocation strategies. After recommending an allocation of a function to human, machine, or combined performance, the tool recommends the role of the human in automated and semi-automated allocation strategies. It allows an analyst to request a consultation to aid in generating a preliminary allocation decision. When asked, the system poses up to 30 questions to the analyst regarding the nature of the function and the implications of the function on overall systems effectiveness. As a result of the pattern of responding to these questions, the system renders an allocation recommendation, which may be accepted or rejected by the analyst.

APPROPRIATE USES:
Man-machine function allocation; allocation trade-offs; development of alternate system design concepts.

EQUIPMENT REQUIRED:
- Apple(r) Macintosh running System 6.0 or higher. HyperCard 2.1 or later. Minimum of 8 megabytes of RAM, 3 megabytes of hard disc drive space.
- IBM PC or compatible running Windows 3.X or Windows 95. Minimum of 8 megabytes of RAM, 3 Megabytes of hard disc drive space.

INPUTS REQUIRED:
- Function name
- Allocation to Man/Machine/Both
- Modes
- Portion Man allocation and mode
- Portion Machine allocation and mode

Two types of question are posed. The first attempts to isolate any function which cannot be allocated to man, or to a machine, due to capabilities, DoD policy, etc. If consideration of a function "passes" several tests for feasibility of man and machine allocation, a second series of questions are asked, otherwise an allocation recommendation is made (if, e.g., the man cannot be allocated a function due to policy, capability, etc., the function must be allocated to the machine, or the system concept must be reconsidered). The second series of questions basically represents a computerized application of a Fitts list. Responses for each question are tallied, and overall weighting toward man or machine allocation is generated.

PROCESSING TECHNIQUES:

Databasing, report generation, heuristic application of allocation rules and strategies.

OUTPUT:
Function allocations.

USES OF OUTPUT:
Function allocation.

DOCUMENTATION:
IDEA/SHIPSHAPE Role of the Person (ROPER) Function Allocation Tool User's Guide.

ALTERNATIVE/COMPARABLE APPROACHES:
Fitts list application.

STAGE OF DEVELOPMENT:
Complete.

VALIDATION:
Statistical/computational modules validated analytically. Database, data logging, and reporting modules validated analytically. Planning modules validated subjectively.

COMMENTS:
Tool originally developed for the U.S. Army. Tool versions exist to support Army, Navy, and Maritime contexts. An upgrade is in development which focuses on collaboration among HSI specialists, subject matter experts, and systems engineers to develop human roles (vs. automation), rules for when function allocations and roles can be dynamically modified to reduce workloads, and alternate conceptual design approaches based on function automation, consolidation, elimination, or simplification.

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: IDEA/SHIPSHAPE Safety Hazard Analyzer, Developer and Evaluator (I-SHADE)

SPONSOR: Carlow International, Inc
POINT OF CONTACT: Dr Thomas B Malone / 703-698-6225
EMAIL: tbmalone@carlow.com
RECORD NO.: HSI00153

GENERAL OVERVIEW:
The IDEA Safety Hazard Analyzer, Developer and Evaluator (I-SHADE) tool was developed for both the IDEA and SHIPSHAPE tool sets. I-SHADE is an automated methodology for establishing a single closed-loop hazard tracking system, and maintaining a centralized "Hazard Log", as required in Task 105 of MIL-STD-882B.

APPROPRIATE USES:
I-SHADE fulfills the requirements for a closed-loop hazard tracking system, and goes beyond the basic requirements to provide an analytic tool for identifying tasks and equipment of special safety concern. I-SHADE is fully password-protected, so that unauthorized personnel cannot modify entered data.

EQUIPMENT REQUIRED:
- Apple(r) Macintosh running System 7.0 or higher. Claris Filemaker Pro(tm). Minimum 8 megabytes of RAM and 5 megabytes of hard disc drive space.
- Apple(r) Macintosh running 7.0 or higher. HyperCard. Minimum 8 megabytes of RAM and 5 megabytes of hard disc drive space.

INPUTS REQUIRED:
I-SHADE is a Filemaker Pro(tm) template and user interface, which aids in the storage, analysis, and retrieval of hazard information. The following data-points are individual I-SHADE fields:
- Hazard Number
- Hazard Identification Date
- Hazard Title
- Name of Person Identifying Hazard
- Source of Hazard Identification
- Name of Cognizant System Safety Point of Contact
- Description of the Cause of the Hazard
- Description of the Probable Effects of the Hazard
- Initial Severity/Probability/Hazard Risk Index of the Hazard
- System Tasks Associated with the Hazard
- System Equipment Associated with the Hazard
- Current Status of Hazard Resolution Efforts
- Name of Cognizant Human Factors Point of Contact
- Name of Cognizant Design Engineering Point of Contact
- Description of HFE Corrective Action
- Description of Final HFE Hazard Resolution
- Final Severity/Probability/Hazard Risk Index of the Hazard after Resolution
- Name of Government Resolution Acceptance
- Date of Government Resolution Acceptance
- Engineering Drawing Number Indicating Resolution.

PROCESSING TECHNIQUES:
Individual records (hazards) within the database can be sub-selected,

sorted, listed, and printed based on any field. Thus, for instance, all hazards associated with a given task or piece of equipment can be identified, or all hazards of a given criticality/probability/risk index, or all items related to heat, toxic gas, or any other selected hazard.

OUTPUT:
I-SHADE can generate:
- reports on all individual hazards in one-page (summary) or two-page (full) formats
- report listings of sub-selected and sorted hazard titles
- summary or full reports on sub-selected and sorted hazards.

USES OF OUTPUT:
Safety issues tracking. Safety analysis reports. Safety program tracking system.

DOCUMENTATION:
IDEA/SHIPSHAPE Safety Hazard Analyzer, Developer and Evaluator (I-SHADE) Tool User's Guide.

ALTERNATIVE/COMPARABLE APPROACHES:

STAGE OF DEVELOPMENT:
Complete.

VALIDATION:
The tool is a database engine for tracking safety issues throughout the life cycle of a system. The tool supports and meets the requirements of MIL-STD-883.

COMMENTS:

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: IDEA/SHIPSHAPE Simulation for Workload Assessment and Modeling (SIMWAM(c))

SPONSOR: Carlow International, Inc
POINT OF CONTACT: Dr Mark Kirkpatrick / 703-208-3453
EMAIL: mkirkpatrick@carlow.com
RECORD NO.: HSI00151

GENERAL OVERVIEW:
The IDEA/SHIPSHAPE Simulation for Workload Assessment and Modeling (SIMWAM(c))tool is used in the IDEA and SHIPSHAPE tool sets. SIMWAM(c) is a microcomputer-based task network modeling technique for assessment of operator/crew workloads, personnel performance problems, performance effectiveness, and system/process throughput times in man-machine systems. It allows the analysts to create a database of task requirements, execute the task network, obtain performance data, and modify the network or tasks in order to evaluate alternate concepts for manning, allocation of tasks to operators, or interface design. Task definitions, flow relationships, and task parameters are based on system documentation, information from subject matter experts, or other appropriate sources. SIMWAM(c) can also execute a network model previously defined using NETWORK(c).

APPROPRIATE USES:
SIMWAM(c) permits an analyst to: create and maintain a database of task requirements; execute the task network; print performance data following the network execution; and modify the task data to evaluate alternate concepts. The interactive nature of SIMWAM(c) allows the analyst to evaluate alternate system design or modification concepts involving manpower reduction, cross-training, automation, task modification, or function allocation. SIMWAM(c) has been used in several military applications to identify the potential for reducing system workloads and manning levels.

EQUIPMENT REQUIRED:
- Apple(r) Macintosh running System 7.0 or higher
- IBM PC running Windows 3.X or Windows 95

INPUTS REQUIRED:
- task network model of system to be analyzed
- task priorities
- predecessor/successor relationships between tasks
- task call structure following task completion
- list of operators qualified to perform each task
- task duration time parameters (minimum, mode, maximum)
- dependence of task duration on process variables (if applicable)
- task interruption parameters
- user-written subroutines (if applicable)

PROCESSING TECHNIQUES:
During a SIMWAM(c) simulation, tasks are called when prior tasks are completed. If sufficient operators are available for a called task, then it will be started. Input data which describe a task include a list of qualified operators and the number of these required to perform the task. In attempting to start a task, SIMWAM(c) will assign qualified operators who are currently idle in the order in which they have been assigned. SIMWAM(c) will attempt to interrupt lower-priority tasks in process in order to obtain operators for higher-prioity tasks. Operators are not necessarily human

operators, but could be any resource entity, such as equipment items. When a task is ready to start, SIMWAM(c) draws a random sample from the probability distribution of duration for the task (unless the minimum, median, or task time parameter is selected). While the task is in process, operator time is accumulated on the task. When a task has been completed, it can call subsequent tasks. If the task call is probabalistic, then one task out of several would be called, depending on specified probabilities. Human error, equipment failure, or a hit or miss following weapon firing are events which could be accomodated by probabalistic task calls. A task can call one or more tasks unconditionally. Task calls can be conditional on simulation events, or variable values by means of user-written subroutines. The ability to integrate subroutines ensures that virtually any logical condition for the start of a task can be accomodated. For example, tasks required to service elements in a queue can be called if and only if one or more object(s) exist in the queue.

OUTPUT:
As SIMWAM(c) executes a network model, it tracks mission time, task completions, task start and end times, time spent per task per operator, and operator utilization. Upon completion of a simulation involving a number of missions (iterations), the means and standard deviations characterizing the entire simulation can be printed and evaluated.

USES OF OUTPUT:
SIMWAM(c) addresses HSI issues in system development, since task duration parameters can reflect equipment changes or automation; operators can be added or deleted to study workload; and effects of cross-training and task reallocation can be evaluated. SIMWAM(c) can model complex man-machine systems with multiple operators who are able to swap tasks, depending on system load.

DOCUMENTATION:
IDEA/SHIPSHAPE Simulation for Workload Assessment and Modeling (SIMWAM(c)) Tool User's Guide.

ALTERNATIVE/COMPARABLE APPROACHES:
MicroSAINT.

STAGE OF DEVELOPMENT:
Operational.

VALIDATION:
The SIMWAM(c) tool has been validated on the efforts to reduce manning on the Fast Sealift Ship, Seawolf Fast Attack Nuclear Submarine, New SSN, Surface Combatant 21st Century (SC 21) Ship, Autonomic Ship, Arsenal Ship, Smart Ship, DDG-51 Ship, LSD-41 Ship, LHA PRI-FLY, CVNs, CV air operations systems, CVX, CIC systems, engineering control/automated auxiliaries, waste management systems, reduced manning bridge, Integrated Survivability Management System, Total Ship Survivability Training System, and DDG-51 accomodation of women program.

COMMENTS:
The interactive nature of SIMWAM(c) allows the analyst to evaluate alternate system design or modification concepts involving manpower reduction, cross-training, automation, task modification, or function allocation. SIMWAM(c) has been used in several military and commercial applications to identify the potential for reducing system workloads and manning levels.

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: IDEA/SHIPSHAPE Task Analysis (I-TASK)

SPONSOR: Carlow International, Inc
POINT OF CONTACT: Mr Christopher C Heasly / 703-698-6225
EMAIL: ccheasly@carlow.com
RECORD NO.: HSI00149

GENERAL OVERVIEW:
The IDEA/SHIPSHAPE Task Analysis (I-TASK) tool, used in the IDEA and SHIPSHAPE tool sets, is based on requirements expressed in MIL-H-46855 and DI-H-7059 (critical task analysis). Task inventory and analysis is performed and reported during development and acquisition of military systems, equipment, and facilities to ensure effective man-machine and man-man interface design, to facilitate effective training program development, testing, and evaluation, and to provide information for manning and workload studies. A database is established to house the task inventory output and task analysis data. According to MIL-H-46955B, all critical tasks, as well as tasks which may compromise safety or which show promise of improved efficiency are to be subjected to a task analysis.

APPROPRIATE USES:
To fulfill Task Analysis requirements as expredd in MIL-H-46855 and DI-H-7059 for critical task analysis.

EQUIPMENT REQUIRED:
- Apple(r) Macintosh running System 6.0 or higher
- HyperCard 2.1 or later.

INPUTS REQUIRED:
The data elements are organized around the following functional headings:

GENERAL: Mission, Function, Task Name, Initiating Tasks, Concurrent Tasks, Successive Tasks, Task Frequency, Task Duration, Criticality, Allocation, Personnel Required/Specialty/Experience, Position, and Machine/System Element

DISPLAY/DECISION: Decision Options, Decision Evaluation Process, Decision Reached, Information Requirements, Information Available, and Communication Requirements

RESPONSE/CONTROL: Action Taken, Control Body Movements, Accuracy/Tolerance, Feedback, Tool/Equipment Requirements, Operator Interactions, and Performance Limitations/Time Constraints

ERROR EFFECTS: Error, Error Indication, Error Consequences, Recovery Constraints

ENVIRONMENT/SAFETY/TRAINING: Environment/Workspace Requirements, Environment/Workspace Constraints, Hazards, Training Objectives, Skill Knowledge Requirements, and Job Performance Aids

The I-TASK tool can utilize data from other IDEA/SHIPSHAPE tools: Role of the Person (ROPER), Comparability Analysis (I-CAN), and NETWORK(c).

PROCESSING TECHNIQUES:
Databasing, report generation, standardization of task nomenclature.

OUTPUT:
Task analysis data form the foundation for subsequent design/engineering studies/analyses. The I-TASK tool provides the analyst a mechanism for producing requirements documents, evaluation criteria design inputs, etc., based on human factors considerations. The cost to develop a task analysis is reduced because of the automation features integrated into I-TASK. Related analyses (and subsequent decisions) are more cohesive because the underlying data are consistent. The data are more accessible because of the search/retrieval and publishing features contained within I-TASK.

USES OF OUTPUT:
I-TASK can also be utilized as a data source for the following:
- Role of the Person (ROPER) Function Allocation tool - system fuctions, man/machine allocations and roles
- Comparability Analysis (I-CAN) tool - task inventories, high-driver tasks
- NETWORK(c) Task Sequencing tool - man/machine allocations, task inventories, task sequences (initiating tasks, subsequent tasks), task completion times (minimum, median, maximum).

DOCUMENTATION:
IDEA/SHIPSHAPE Task Analysis (I-TASK) Tool User's Guide.

ALTERNATIVE/COMPARABLE APPROACHES:
Several comparable automated task analysis tools are in existence.

STAGE OF DEVELOPMENT:
Beta testing. Interested users are asked to contact the POC.

VALIDATION:
The IDEA/SHIPSHAPE I-TASK tool was validated on the efforts to reduce manning on the Fast Sealift Ship, Seawolf Fast Attack Nuclear Submarine, New SSN, Surface Combatant 21st Century (SC 21) Ship, Autonomic Ship, Arsenal Ship, Smart Ship, DDG-51 Ship, LSD-41 Ship, LHA PRI-FLY, CVNs, CV air operations systems, CVX, CIC systems, engineering control/automated auxiliaries, waste management systems, reduced manning bridge, Integrated Survivability Management System, Total Ship Survivability Training System, and DDG-51 accomodation of women program.

COMMENTS:

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: IDEA/SHIPSHAPE Task Sequencing (NETWORK(c))

SPONSOR: Carlow International, Inc
POINT OF CONTACT: Mr Christopher C Heasly / 703-698-6225
EMAIL: ccheasly@carlow.com
RECORD NO.: HSI00150

GENERAL OVERVIEW:
The IDEA/SHIPSHAPE Task Sequencing (NETWORK(c)) tool is used in the IDEA and SHIPSHAPE tool sets. Human Systems Integration (HSI) initiatives often require the representation of a man-machine system as a network of tasks performed by operators or maintainers. Operational sequence diagrams and task flow charts, used in connection with task analysis, provide examples of the graphic representation of a network of tasks. In these graphic approaches, tasks are represented as nodes (or boxes), and branches between tasks (arrows) indicate the sequence in which tasks are performed. NETWORK enables the HSI analyst to quickly develop a functional model of a system and depict the model in graphic format. The graphic model provides the capability to identify required functions and tasks, and to determine the temporal, spatial, causal, and cooperational relationships among functions and tasks in a manner that is quickly achieved and easily modified and updated.

The benefit of the NETWORK(c) tool is primarily that it enables the HSI analyst to quickly develop a functional model of a system, and depict the model in graphic format. The graphic model provides the capability to identify required functions and tasks, and to determine the temporal, spatial, causal, and cooperational relationships among functions and tasks in a manner that is quickly achieved and easily modified and updated.

EQUIPMENT REQUIRED:
Apple(r) Macintosh running System 7.0 or higher.

INPUTS REQUIRED:
Functional/task flows of evolving and/or baseline systems.

PROCESSING TECHNIQUES:
NETWORK(c) is a tool which runs on the Apple(r) Macintosh computer, which takes advantage of the Macintosh graphics capabilities and user interface to allow an analyst to draw a task network. A set of drawing tools is provided to generate, locate, and connect task boxes. A task box can be named and then opened to produce a set of dialog windows. These allow the analyst to input particulars about a given task, including such things as the operator(s) qualified to perform the task, the priority of the task, conditions which must be met before the task can be started, and parameters which specify the probability distribution of completion time for the task.

OUTPUT:
Once a Task network has been defined, it can be exported to the IDEA Task Analysis (I-TASK) tool for detailed analysis of requirements and characteristics of the tasks, exported to the IDEA SIMWAM(c) for simulation of the task network, printed in hardcopy, and/or exported to one of the Macintosh graphics applications for documentation purposes. (SIMWAM(c) - Simulation for Workload Assessment and Modeling - is a workload assessment

modeling tool that is used to simulate task networks to evaluate system/ process performance.)

USES OF OUTPUT:
(See OUTPUT, above.)

DOCUMENTATION:
IDEA/SHIPSHAPE Task Sequencing (NETWORK(c)) Tool User's Guide.

ALTERNATIVE/COMPARABLE APPROACHES:

STAGE OF DEVELOPMENT:
Beta testing. Interested users are asked to contact the POC. A PC version is currently planned.

VALIDATION:
The NETWORK(c) tool was validated through application to the Integrated Survivability Management System.

COMMENTS:
Carlow International is in the process of upgrading the NETWORK(c) tool to enable a hierarchical depiction of functions and tasks.

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: IDEA/SHIPSHAPE Tradeoff Analysis (ITALIC)

SPONSOR: Carlow International, Inc
POINT OF CONTACT: Dr Thomas B Malone / 703-698-6225
EMAIL: tbmalone@carlow.com
RECORD NO.: HSI00152

GENERAL OVERVIEW:
The IDEA/SHIPSHAPE Tradeoff Analysis (ITALIC) tool, used in the IDEA and SHIPSHAPE toolsets, enables the analyst to quickly conduct tradeoffs of alternative candidate concepts, and to generate reports of tradeoff results in text or graphic format. The ITALIC tool is written in HyperCard for the Apple Macintosh computer. The tool consists of 4 functional elements: 1) the SetUp Screen, 2) the Assessment Screen, 3) the Summary Screen, and 4) the Plot Screen.

The SetUp Screen: Provides the capability to define the scope and content of the tradeoff.
The Assessment Screen: Provides the capability to assess the relative merits of each alternative for each of the weighted criteria.
The Summary Screen: Evaluates the progress of the tradeoff at any point during the Assessment.
The Plot Screen: If the user prefers a graphic representation of his data, the ITALIC tool will plot the weighted scores for each alternative for a specific criterion. The scores are plotted in terms of their variance from the mean score.

APPROPRIATE USES:
Use of the ITALIC tool can be expected to reduce the time required to set up and conduct tradeoffs by a factor of 10.

EQUIPMENT REQUIRED:
- Apple(r) Macintosh running System 6.0 or higher.
- HyperCard 2.1 or later.

INPUTS REQUIRED:
SETUP CARD: The SetUp Screen provides the capability to define the scope and content of the tradeoff, and the capability for the user to save lists of alternatives and weighted criteria, so that they may be retrieved and used in subsequent tradeoffs. The SetUp Screen contains:
- an Alternative Field for listing up to 10 alternatives for the current tradeoff
- a Criteria Field for typing in or selecting from a list of 30 standard criteria (accuracy, life-cycle cost, MTBF, etc.)
- a Weights Field in which the user enters weights for each of the criteria.

ASSESSMENT CARD: On completion of the setup, the user opens the Assessment Screen, which provides the capability to assess the relative merits of each for each of the weighted criteria, using alisting of the alternatives with a "sliding marker" next to each alternative.

SUMMARY CARD: At any point during the assessment, the user can access the Summary Screen to evaluate the progress of the tradeoff, using a summary of all the assessments completed up to that point in the tradeoff, including mean scores for each alternative and criterion. The user can scroll through

the list of criteria to see the weighted score for each alternative for each criterion. The user can save the contents of the summary card to a tab-delimited text file, which can be retrieved by the ITALIC tool for subsequent assessments, or opened by a database or spreadsheet program for additional analysis.

PLOT CARD: If the user prefers a graphic representation of his data, the ITALIC tool will plot the weighted scores for each alternative for a specific criterion. The scores are plotted in terms of their variance from the mean score.

PROCESSING TECHNIQUES:

OUTPUT:
Results of the tradeoffs include graphic plots and/or text descriptions of the performance of each alternative on each criterion.

USES OF OUTPUT:

DOCUMENTATION:
IDEA/SHIPSHAPE Tradeoff Analysis (ITALIC) Tool User's Guide.

ALTERNATIVE/COMPARABLE APPROACHES:
Tradeoff analysis tools.

STAGE OF DEVELOPMENT:
Complete and operational.

VALIDATION:
The tool has been validated in several design efforts.

COMMENTS:

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: Improved Performance Research Integration (IMPRINT) Tool

SPONSOR: Army Research Laboratory (ARL-HRED)
POINT OF CONTACT: Dr Laurel E Allender / 410-278-6233, DSN: 298-6233
EMAIL: lallende@arl.mil
RECORD NO.: HSI00177

GENERAL OVERVIEW:
IMPRINT, developed by the Human Research & Engineering Directorate of the U.S. Army Research Laboratory, is a stochastic network modeling tool designed to help assess the interaction of soldier and system performance throughout the system lifecycle -- from concept and design through field testing and system upgrades. IMPRINT is the integrated, Windows follow-on to the Hardware vs. Manpower III (HARDMAN III) suite of nine separate tools.

APPROPRIATE USES:
IMPRINT is appropriate for use as both a system design and acquisition tool, and a research tool. IMPRINT can be used to help set realistic system requirements, identify soldier-driven constraints on system design, and to evaluate the capability of available manpower and personnel to effectively operate and maintain a system under environmental stressors. IMPRINT incorporates task analysis, workload modeling, performance shaping and degradation functions and stressors, personnel projection model, and embedded personnel characteristics data.

IMPRINT uses Micro Saint, an embedded discrete event task network modeling language, as its engine. Task-level information is used to construct networks representing the flow and the performance time and accuracy for operational and maintenance missions. IMPRINT is used to model both crew and individual soldier performance. For some analyses, workload profiles are generated so that crew-workload distribution and soldier-system task allocation can be examined. Using the "Advanced" workload method, detailed interface designs can be evaluated, as can workload coping strategies. In other cases, maintainer workload is assessed along with the resulting system availability. Also, using embedded algorithms, IMPRINT models the effects of personnel characteristics, training frequency, and environmental stressors on the overall system performance. Manpower requirements estimates can be used as the basis for estimating manpower lifecycle costs.

EQUIPMENT REQUIRED:
The minimum requirements are an IBM-compatible PC running under Windows 3.11, Windows for Workgroups, Windows 95, or Windows NT, 16MB RAM (32MB preferred), minimum of 50MB disc space, and a VGA monitor. No additional software is required, and IMPRINT is copy-and-paste-compatible with popular Windows text editors, spreadsheets, and graphing packages.

INPUTS REQUIRED:
Input requirements vary according to type of analysis performed. Examples of input include mission-function-task breakdown, task time and accuracy, failure consequence, system-subsystem-component breakdown, mean operational units between failure (MOUBF), and level of environmental stressors (e.g., heat, cold, noise, etc.).

PROCESSING TECHNIQUES:
Dynamic, stochastic, discrete event modeling; personnel projection or "flow" model.

OUTPUT:
A broad spectrum of both detailed and summary reports are available, as well as detailed printouts. Graphics and workload levels, and task networks, as well as timeline of task performance and diagnostic reports of subfunction and task failures, are available.

USES OF OUTPUT:
The various analysis capabilities in IMPRINT provide output appropriate for use by the system design and acquisition communities, MANPRINT practitioners, researchers, managers, and decision and policy makers.

DOCUMENTATION:
Limited online help available; full documentation will be available with version 4.0.

ALTERNATIVE/COMPARABLE APPROACHES:
Related approaches: WinCrew, Micro Saint, Manpower, Personnel, Training Decision Support System (MPTDSS), Army Manpower Cost System (AMCOS).

IMPRINT replaces these HARDMAN III modules: System Performance And RAM Criteria Estimation Aid (SPARC); Manpower Constraints Estimation Aid (M-CON); Personnel Constraints Estimation Aid (P-CON); Training Constraints Estimation Aid (T-CON); Manpower-Based System Evaluation Aid)MAN-SEVAL); Personnel-Based System Evaluation Aid (PER-SEVAL); Manpower Capability (MANCAP); Force Analysis Aid (FORCE); and Human Operator Simulator (HOS) V.

STAGE OF DEVELOPMENT:
Version 3.27 is currently available. Version 4.0 will be available later in 1998.

To obtain copies of the software and/or documentation, write: Director, U.S. Army Research Laboratory, Human Research and Engineering Directorate, Attn: AMSRL-HR-MB (Dr. Allender), Aberdeen Proving Ground, MD 21005-5425.

VALIDATION:
HARDMAN III, and now IMPRINT, are being subjected to a verification, validation and accreditation (VV&A) process, Phase I of which was completed in January, 1995.

COMMENTS:
IMPRINT has unlimited distribution to Government agencies and their contractors, and distribution to universities and foreign governments on a per-request basis.

Visit our Website at:
http://www.arl.mil/ARL-Directorates/HRED/imb/imprint/imprint.htm.

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: Information Processing/Perceptual Control Theory (IP/PCT) Model

SPONSOR: Defence and Civil Institute of Environmental Medicine
POINT OF CONTACT: Mr Keith Hendy / 416-635-2074, DSN: 827-2074
EMAIL: kch@dciem.dnd.ca
RECORD NO.: HSI00088

GENERAL OVERVIEW:
The IP/PCT model provides an integrating framework for understanding the origins of operator workload and the relationship of workload to concepts such as cognitive compatibility ans situation awareness. It provides insight into individual and team decision making. The IP/PCT model can be given quantitative form, as is demonstrated in the Integrated Performance Modeling Environment (IPME) software for task network analysis (see entries for IPME, HSI00162, and SOLE/IPME, HSI00186).

APPROPRIATE USES:
As a framework for understanding operator information processing limitations and their impact on perceptions of workload, error production, and performance. The IP/PCT model can be encoded for embedding software for task network simulation. It is not a trivial activity to code the full model into standard software, such as MicroSaint; however, the IP/PCT model has been incorporated into a commercially available software environment (IPME from Micro Analysis and Design -- as above, see entries for IPME and SOLE/IPME).

EQUIPMENT REQUIRED:
N/A

INPUTS REQUIRED:
As a descriptive model, no quantitative data are required. When embedded in a program for task network analysis, certain data describing the tasks and task sequences are required. This is described in the SOLE/IPME entry (see HSI00186).

PROCESSING TECHNIQUES:
Through a simple application of information processing theory, the IP model reduces all workload effects to their action on the amount of information to be processed, or the time available for processing. Various diffusely acting psychological and physiological stressors are claimed to affect the rate at which information can be processed (in bits per second), and so affect decision times. For most applications of the IP model, it is only necessary to accept the underlying concepts of the model. It is not necessary to actually measure the amount of information being processed for the model to be useful. The PCT models are complementary. The IP model sits within the PCT framework at all points where information is actively processed.

OUTPUT:
The IP/PCT model integrates most factors that one associates with operator workload and situation awareness into their effect on time, knowledge, and attention. These three factors are inextricably bound up so that they always trade-off, one against another. The IP/PCT provides a framework for understanding how human information processing limitations impact on performance. When used in the qualitative sense, this knowledge is the output. When used as a predictive model, say, in a task network simulation, the IP model provides a metric of operator workload and performance.

USES OF OUTPUT:
Understanding the relationships between human information processing limitations, perceived workload, situation awareness, cognitive compatibility, and team performance; for example, the IP/PCT model has been used as a framework for designing a new approach to Crew Resource Management (CRM) training. From the IP/PCT model, a behaviorally anchored rating scale has been devised to assess resource management performance in terms of the timeliness and appropriateness of decisions and the overall management of time, knowledge, and attention. The IP/PCT model can be used in performance prediction tools that fulfill the activities recommended ina MIL-HDBK-46855 front-end human engineering analysis.

Analyst Qualifications: 1-5 yrs. HFE experience; familiarity with the literature on operator workload.

DOCUMENTATION:
Hendy, K.C. and Farrell, P.S. (1997), "Implementing a Model of Human Information Processing in a Task Network Simulation Environment" (DCIEM 97-R-71), North York, Ontario, Canada: Defence and Civil Institute of Environmental Medicine.

Hendy, K.C., Liao, J. and Milgram, P. (1997), "Combining Time and Intensity Effects in Assessing Operator Information Processing Load", Human Factors, 39(1), 30-47.

Hendy, K.C., Liao, J., and Milgram, P. (1994). Combining time and intensity effects in assessing operator information processing load. (Submitted to Human Factors).

ALTERNATIVE/COMPARABLE APPROACHES:
Multiple Resource Theory, W/INDEX, Wingert's functional interface method. The IP/PCT model incorporates aspects from many models, and, therefore, is both comparable to and different from these other approaches at the same time.

STAGE OF DEVELOPMENT:
N/A

VALIDATION:
For information regarding the following validation studies, please contact the POC:

East, K.P., Hendy, K.C. and Matthews, M. (1996), "Validation of an Information Processing-Based Model for Workload and Performance Prediction", in Proceedings of the Human Factors Society of Canada, 29th Annual Conference, Mississauga, Ontario, Canada: Human Factors Association of Canada, 155-160.

Hendy, Liao and Milgram (1997) (see DOCUMENTATION, above).

COMMENTS:

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: INJURY 5.0

SPONSOR: Walter Reed Army Institute of Research
POINT OF CONTACT: LTC Maria Mayorga / 301-295-7447, DSN: 295-7447
RECORD NO.: HSI00103

GENERAL OVERVIEW:
INJURY 5.0 is a blast overpressure predictive injury model that will be used to predict combat survivability of soldiers, give guidance for firing restrictions during training, and to aid in the development and procurement of safer weapon systems. It will contain a Health Hazard Assessment Methodology that allows a precise estimate of the hazard in a given blast environment (prediction of probability of injury at any confidence level) and a basis to evaluate model predictions in prospective tests.

APPROPRIATE USES:
To aid in the development and procurement of safer weapons, give guidance for firing restrictions during training, and for the prediction of combat survivability of soldiers.

EQUIPMENT REQUIRED:
Personal computer running MS Windows 3.1

INPUTS REQUIRED:
Blast overpressure pressure-time histories in GDIF or TDR format.

PROCESSING TECHNIQUES:
Numerical integration of biodynamic model equations.

OUTPUT:
Calculates lung work and tracheal stress to predict incidence of no, trace, mild, moderate and severe lung injury, and overall incidence of any tracheal injury from blast overpressure exposure.

DOCUMENTATION:
User manual and on-line help.

ALTERNATIVE/COMPARABLE APPROACHES:
Military Standard 1474C

STAGE OF DEVELOPMENT:
INJURY 4.0 (current version) - released to blast community on an as-needed basis.

INJURY 5.0 (upgrade with statistical Health Hazard Assessment Methodology) - upgrades to include predictions for injury for other organ systems planned.

Contact POC to obtain.

VALIDATION:
Retrospectively validated against a shoulder-fired weapon simulation study conducted at the Blast Overpressure Test Site, Albuquerque, NM.

COMMENTS:
None.

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: Integrated Performance Modeling Environment (IPME)

SPONSOR: Micro Analysis and Design, Inc
POINT OF CONTACT: Mr Dave Dahn / 303-442-6947
EMAIL: ipme@maad.com
RECORD NO.: HSI00162

GENERAL OVERVIEW:
The Integrated Performance Modeling Environment (IPME) is an integrated environment of models intended to help the human factors practitioner analyze human-system performance. IPME provides:

- a more realistic representation of humans in complex environments
- interoperability with other model components and external simulations
- enhanced usability through a user-friendly graphical user interface

APPROPRIATE USES:
Human performance modeling

EQUIPMENT REQUIRED:
Silicon Graphics IRIX machines running X11R5 or later with the Motif 1.2.3or later window manager, and 16 MB of RAM minimum; IPME also runs on Linux distributions for any hardware using X11R6 and Motif 2.0.

INPUTS REQUIRED:
Tasks, timing information, curve-fitting information, stressors on the operators.

PROCESSING TECHNIQUES:

OUTPUT:
IPME contains a simple socket protocol to allow passing variables information from external applications.

USES OF OUTPUT:
Queueing analysis, decisions on operators in complex situations, task failure, and hierarchical representation of tasks.

Some HF and programming experience is helpful.

DOCUMENTATION:
IPME manual and users guide are available.

ALTERNATIVE/COMPARABLE APPROACHES:
This is unique software that is at the cutting edge of HF technology.

STAGE OF DEVELOPMENT:
Version 1.2.18

VALIDATION:
The micro-models have been validated.

COMMENTS:
Training is available onsite or in Boulder, CO. See Website at www.maad.com for more information.

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: Intergraph's Engineering Modeling System (EMS) Software

SPONSOR: Army Tank Automotive Command
POINT OF CONTACT: Mr Steven Patterson / 810-574-8600, DSN: 786-8600
EMAIL: patterss@cc.tacom.army.mil
RECORD NO.: HSI00024

GENERAL OVERVIEW:
EMS software integrates the crew into the conceptual design of existing and future combat, tactical, and special-purpose vehicles which meet current and long-range requirements of the Army.

APPROPRIATE USES:
The appropriate use for EMS software is to determine whether: there is sufficient crew space; all controls are accessible; and the protection levels for the crew are sufficient.

EQUIPMENT REQUIRED:
The equipment needed to use EMS software is the Intergraph Computer-Aided Design (CAD) system, or an equivalent CAD system which can translate Initial Graphics Exchange Specification (IGES) parts, and/or International Standard for the Exchange of Product Model Data (STEP) parts.

INPUTS REQUIRED:
The inputs required to use EMS software include: engineering drawings of vehicles and components, lists of component weights, and lists of materials for the vehicle design.

PROCESSING TECHNIQUES:
The processing of input consists of manually inputting the data. This data can be combined into a single design file, and/or incorporated into a database for future concepts.

OUTPUT:
Output from EMS software may consist of a computer-generated solid model(s), overall three-view drawing(s), and overall weight study (including center of gravity).

USES OF OUTPUT:
Output data from EMS software can be used to determine compartmentalization and packaging of components, conceptual design feasibility, and trade-off analyses. Also, data files created with EMS software can be used for further analysis in software programs such as Dynamic Analysis Design System (DADS), Finite Element Modeling System (FEM), NATO Reference Mobility Model, and Ballistics Research Lab CAD (BRL-CAD).

DOCUMENTATION:
None.

ALTERNATIVE/COMPARABLE APPROACHES:
Intergraph's computer SAMMIE model -- it is a more intelligent model than EMS.

STAGE OF DEVELOPMENT:
Work is completed on the development of the 3D solid model.

COMMENTS:
Another design software for conceptual design is "ProEngineer", manufactured by Parametric Technology Corporation. Contact the POC for more information.

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: JA! (JavAnimator)

SPONSOR: Wise Web Ware
POINT OF CONTACT: Dr Joel A Goldstein / 910-274-3316
EMAIL: jgoldstn@hotmail.com
RECORD NO.: HSI00170

GENERAL OVERVIEW:
A tool allowing users to import still images and/or create still images, set parameters to create and operate Java-based animations over any operating system or browser.

APPROPRIATE USES:
Demonstrations, Web pages, CAI, CBT

EQUIPMENT REQUIRED:
PC, UNIX Workstation, Macintosh

INPUTS REQUIRED:

PROCESSING TECHNIQUES:
Import still images as sprites; draw new still images; set parameters for animation operation.

OUTPUT:
Animation

USES OF OUTPUT:
Web pages, instruction, demonstration

DOCUMENTATION:
Available from: http://www.WiseWebWare.com; or e-mail, telephone, or written request (see addresses and telephone above).

ALTERNATIVE/COMPARABLE APPROACHES:

STAGE OF DEVELOPMENT:

COMMENTS:
Available free to employees of US DoD; available at 35% discount to other US Government civilian employees, State and local government agencies, and defense contractors.

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: Knowledge Base Development Tool (KBDT)

SPONSOR: Prospective Computer Analysts, Inc
POINT OF CONTACT: VP Greg Winter / 516-742-9100
EMAIL: gregwinter@worldnet.att.net
RECORD NO.: HSI00137

GENERAL OVERVIEW:
The Knowledge Base Development Tool (KBDT) is a Windows-based, multimedia tool which assists in the capture and maintenance of any and all data types, including video, audio, graphics, pictures, bitmaps, and text. Information is captured, archived to a central repository or compact disc (CD), and is available to users via Windows-capable, mouse-driven, user-friendly programs. The KBDT can be used to capture expert knowledge, loss of experienced personnel, digitized hardcopy, and as a training tool. At any time, data may be accessed from remote sites via networking and/or modem, or be written to CD for distribution to offsite or remote facilities and activities.

APPROPRIATE USES:
The KBDT is a valuable, easy-to-use tool for capturing, accumulating, storing, and distributing information, doing so in a cost-effective and timely manner. Training personnel, costs, and scheduling are all exercised in a more effective manner when utilizing the KBDT. The KBDT can be used to archive policies and procedures, technical documentation, personnel records, and a multitude of other data and databases. Any information adhereing to open database connectivity may be integrated. Maintenance and/or updates may be easily performed on a regular schedule, or as the changes occur. Access to the information is enhanced by simple mouse pointing/clicking and also by using hypertext (launch information by clicking an area of interest). This tool can be utilized in any environment, be it DoD or commercial arenas.

As a reference library, or as an interactive repository and/or CD training tool, the KBDT can assist in making operations more efficient and effective.

EQUIPMENT REQUIRED:
CD review/interaction: 486/66 MHz or higher CPU, 8 MB RAM, CD-ROM, sound card/speakers, Microsoft Windows 3.1 or higher, 5 MB hard disc space.

Total development production system -- add: 150 MB hard disc space, Microsoft Visual Basic, Sheridan Software's Data Widgets, video capture card and production software, CD writer and software.

INPUTS REQUIRED:
The data contained in the KBDT is generated and/or integrated initially with PCA and prospective users' joint input and development. Once the baseline knowledge base has been generated, CDs may be written and distributed. Interaction is by moving and clicking the mouse, accessing areas of interest within the knowledge base. If the user wishes to update the knowledge base and consequential CDs, the user will provide the information to PCA for update, or be trained to become familiar with the KBDT tp perform an update independently.

OUTPUT:
CDs can be generated for user interaction and distribution. Additionally,

online and/or hardcopy reports may be generated reflecting specific areas of interest contained within the knowledge base. If so desired, ad hoc (specialized) reports, or listings of selected topics, may be generated.

USES OF OUTPUT:
Output may be utilized for training, user reference and/or review, hardware review in the field, and as comment references for updates, changes, and enhancements to the knowledge.

DOCUMENTATION:
KBDT Operations Guide; Microsoft Windows Users Guide.

ALTERNATIVE/COMPARABLE APPROACHES:
Other vendors developing multimedia training tools.

STAGE OF DEVELOPMENT:
Copyright 1994-1996; tools, procedures, and expertise available; task generation upon specific identification of effort.

COMMENTS:
"A user-friendly, cost-effective, knowledge base and training tool."

Alternate POCs: Harv Oliver, Systems Engineer
601 Daily Dr., Ste. 127
Camarillo, CA 93010
Phone: 805-383-0386 / FAX 805-383-0317
E-Mail: holiver106@aol.com

Scott Miller, Software Engineer
1224 10th St., Ste. 207
Coronado, CA 92118
Phone: 619-435-0300 / FAX 619-435-0172
E-mail: procomalys@aol.com

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: LOCATE

SPONSOR: Defence and Civil Institute of Environmental Medicine
POINT OF CONTACT: Mr Keith Hendy / 416-635-2074, DSN: 827-2074
EMAIL: kch@dciem.dnd.ca
RECORD NO.: HSI00185

GENERAL OVERVIEW:
LOCATE is a computer-aided tool for analyzing the strength of communication, in the visual, auditory, tactile, and movement domains, in multi-operator-machine workspace layout problems. LOCATE uses a form of link analysis that is sensitive to both the length and angular properties of the link. Transformation functions approximate the visual, auditory, and movement properties of the humans and machines in the workspace. The link strength components for each human-human, human-machine, and machine-machine interaction are rolled up into a single cost function. Matrices of component costs are also presented for the purposes of disgnosis.

LOCATE is currently restricted to the two-dimensional layout problem, although conceptually it could be extended to three dimensions at some time in the future. LOCATE was designed to interface with mathematical optimization techniques that can operate on the positions and orientations of individual workstation elements to produce a minimum cost layout. LOCATE is not currently linked with an optimization package.

LOCATE was developed using Platform Independent Graphic User Interface (PIGUI) software. This software is linked to an expert system shell. LOCATE has a proof-of-concept adaptive help system that monitors keystrokes and menu use, and provides tailored help to the user. LOCATE is also linked to a browser for access to data sources on the Internet.

APPROPRIATE USES:
To assist in the layout of multi-operator-machine workspaces, such as ship's bridges, operations rooms, command and control centers, material-handling environments, and workshop floors. LOCATE was built specifically to be applicable to the design of workspaces that were within the near-to-far range of human sensory capabilities. In certain circumstances, LOCATE may have application to panel design or to single-operator workstations.

EQUIPMENT REQUIRED:
LOCATE is easily portable to a variety of operating systems running on some 40 hardware platforms, but requires the purchase of a development system for the target platform, and approximately two to four weeks to port the software. Currently tested on Mac OS 7.1 and higher; Windows 95; minimum 68030 (MAC) or 486 (PC) -- preferred, Power Mac, Pentium 166+-compatible; minimum 8 MB RAM for the application (preferred, 16 MB); 8 MB hard drive; Super VGA (PC) video card; Open Transport and OS 7.6.1 or higher for access to Internet Help Files (MAC) (Internet access not yet tested on PC).

INPUTS REQUIRED:
LOCATE requires no more or no less data than an equivalent conventional layout analysis. The type of data required is dependent on the specific application (e.g., the nature and function of the workspace). Typically, one would need to know the physical characteristics of the individual workstation elements, the prescence of fixed obstructions in the floorplan,

the characteristics of audio and visual sources of information within the workspace, the environmental parameters that apply to the workspace, a basic function or task analysis, the priority of all communication links (this could be based on frequency of use, for example), and the relative priority of each communication domain. In essence, the information required is the information one has always had to consider in doing a comprehensive human engineering analysis of a workspace.

Use standard human engineering references, experiments if required, or direct observation. Video and audio capture is often appropriate.

Engineering drawings, human engineering standards, design handbooks and guides, movement analyses, display specifications (font size, acceptable viewing angles, etc.), environmental analyses (noise, vibration, lighting levels, dust, smoke, haze, etc.), and similar environments.

PROCESSING TECHNIQUES:
Generally, no specific data manipulation is called for. LOCATE makes extensive use of default values to reduce the amount of time spent before preliminary cost functions can be run.

Link lengths and link angles between individual workstations are passed through various transformation functions that approximate the visual, auditory, and reaching capabilities of the human operators to produce an estimate of the strength or quality of a given communication link. Similar transformation functions specify the characteristics (readability, audibility, reachability, etc.) of the displays and controls within the workspace. Separate link strengths are calculated for each workstation as both a source of information and as a receiver of information. Link strengths are attenuated by obstructions to vision, audition, reaching, and movement in the workspace. Individual link strengths are converted into a cost (1-strength), weighted by their priority both within and across domains, and additively combined into an overall cost function. The cost function is doubly differentiable and, so, compatible with standard optimization procedures. Optimization is not trivial. The cost function is of high dimensionality, is non-linear, and subject to non-linear constraints. The cost function is not generally representable in an analytic form, and so must be nemerically differentiated.

OUTPUT:
The output of LOCATE is a single value of the cost associated with a particular configuration, as well as the incremental costs associated with each pairwise relationship between workstations, in each communication domain (vision, audition, tactile, movement) and across all communication domains. These data are presented in both textual format (a single number, or a matrix of costs associated with each pairwise combination of workstations) and graphically (the ability to define 4 cost function ranges and color the cost matrix according to membership within each range). The level of detail (overall cost or incremental cost by domain) is user-selectable. Domains can be enabled or disabled for separate analyses (visual, auditory, tactile, or movement domains in any combination). When an optimizeris attached, LOCATE generates configurations that attempt to minimize the overall cost. LOCATE imports and exports DXF files translating the workspace configuration from, and back into, standard drafting packages. Cost function results can be cut-and-pasted into spreadsheets and word processing packages.

USES OF OUTPUT:
Arranging workstations within a two-dimensional workspace, so that good

communication is possible by visual, audible and tactile means, and movement patterns are facilitated.

Analyst qualifications: 2-3 yrs. HFE experience; 4 hrs. training on the tool.

No formal training is in place; LOCATE comes with a tutorial.

DOCUMENTATION:
Hendy, K.C. (1984), "'LOCATE': A Program for Computer-Aided Workspace Design" (Minor Thesis, Master of Engineering Science), Clayton, Victoria, Australia: Dept. of Electrical Engineering, Monash University.

Hendy, K.C. (1989), "A Model for Human-Machine-Human Interaction in Workspace Layout Problems", Human Factors, 31(5), 593-610.

Hendy, K.C., Liao, J., and Milgram, P. (1994). Combining time and intensity effects in assessing operator information processing load. (Submitted to Human Factors).

ALTERNATIVE/COMPARABLE APPROACHES:
CORELAP, ALDEP, CRAFT, PLANET, and DISCON are alternative techniques that have been applied to this type of problem. None are strictly comparable, as they vest all the information about the quality of a communication link entirely in the distance between elements.

STAGE OF DEVELOPMENT:
The current version of the software is 1.0. This is the initial release version. The software is quite mature so far as reliability and stability are concerned; however, some minor features and embellishments are missing. LOCATE may be offered for commercial exploitation after further usability evaluation.

Four major developments are planned when funding is available: (1) the addition of an optimizer (this will be a plug-in); (2) the extension of the rule base and capability in the 'intelligent' help facility, including a tutorial for new users; (3) linking LOCATE to various HE guides, standards, handbooks, and other HE resources via the Internet; and (4) providing remote access to LOCATE over the Internet.

The software is available to the Departments of Defense of Australia, Canada, New Zealand, United Kingdom, and the United States and their contractors, under the terms of the TTCP agreement.

VALIDATION:
See Hendy, K.C. (1984, 1989) in DOCUMENTATION, above.

Hendy, K.C., Berger, J., and Wong, C. (1989), "Analysis of DDH280 Bridge Activity Using a Computer-Aided Workspace Layout Program (LOCATE) (DCIEM 89-RR-18), North York, Ontario, Canada: Defence and Civil Institute of Environmental Medicine.

COMMENTS:
For details on the development of this software, contact:
Jack L. Edwards, President

AI Management & Development Corp.
206 Keewatin Ave.
Toronto, ON, Canada M4P 1Z8
(416) 488-6068 / FAX (416) 486-6013
jle@interlog.com
http://interlog.com/~jle (for tool information)

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: Logistics Composite Model (LCOM)

SPONSOR: Aeronautical Systems Center
POINT OF CONTACT: Mr Dick Cronk / 937-255-8060, DSN: 785-8060
EMAIL: cronkra@xrease.wpafb.af.mil
RECORD NO.: HSI00086

GENERAL OVERVIEW:
LCOM is a Monte Carlo simulation model, written in SIMSCRIPT II.5 and is used to model the interaction of maintenance, operations, and supply functions for any type of system (mechanical, electronic or weapon system).

APPROPRIATE USES:
The model can and has been used to develop and analyze a baseline comparison system as described in MIL-STD-1388-1A, Task 203. The model can and has been used to perform tradeoffs and evaluations as described in MIL-STD-1388-1A, Task 303. The model can and has been used to evaluate the interaction of any of the following Integrated Logistics Support elements: 1) Maintenance Planning; 2) Facilities; 3) Design Interface; 4) Support Equipment; 5) Manpower & Personnel; 6) Supply Support; and 7) Packaging, Handling, Storage and Transportation (PHS&T).

EQUIPMENT REQUIRED:
The model is running on the following UNIX platforms:
Sun using SUN OS; Sun using SOLARIS; IBM RISC 6000 using AIX; Vax using ULTRIX-32; Hewlett Packard; and Silicon Graphics.

INPUTS REQUIRED:
Since LCOM has been in use for over twenty years, much work has been done on input data sources. The following is a description and current status of those data sources: 1) USAF Maintenance Data (D056 or CAMS/REMIS) - Automated data extractions and conversion programs are in use; 2) NAVY 3M Data - Data extraction queries have been developed for use with the Naval Aviation Logistics Data Analysis (NALDA) system. The manual conversion process of the data to LCOM input format is being automated; 3) MIL-STD-1388-2A Logistics Support Analysis Record (LSAR) - An automated data extraction and conversion program from the LSA Control Number Master File to LCOM format is in use; 4) MIL-STD-1388-2B LSAR (Relational DBMS) - The data elements requiring extraction have been identified. One contractor already has an in-house extraction and conversion program; 5) National Stock Numbers (NSN) - Manual data extraction is in use. No conversion is needed since the entire NSN can be input into the 18-character LCOM task name; and 6) MIL-STD-1808, Notice 1, System/Subsystem/Subject Number (S/S/SN) - One contractor already has an in-house conversion program to LCOM.

PROCESSING TECHNIQUES:
The execution of the simulation for single or multiple replications is controlled by an LCOM menu. Selections are made by the user and executable C shell scripts are created. These C shell scripts are then submitted by the user for execution. When multiple replications are desired, the C shell scripts also execute programs that merge the output files and computes means, variances, and standard deviations for statistics across the multiple replications.

OUTPUT:
The LCOM analyst can utilize over 140 built-in statistics, schedule

specialized reports at any time or frequency during the simulation, or execute post-processor programs for detailed analysis of events that happened during the simulation. The 140 built-in statistics are grouped together into eight major categories:

1) Operations
2) Non-flying Activities
3) Aircraft
4) Personnel
5) Shop Repair
6) Supply
7) Support Equipment
8) Facilities

The specialized reports allow "snapshot" looks at what is happening during the simulation. The five post-processor programs: 1) provide a graphical aircraft timeline display; 2) provide mission success statistics; 3) provide a graphical manpower utilization matrix display; 4) provide a graphical support equipment & facilities; and 5) provide desired spares quantities based on peacetime and economic ordering rules.

USES OF OUTPUT:
Output from LCOM can be used to develop and analyze a baseline comparison system, or perform tradeoffs and evaluations of the various Integrated Logistics Support elements.

DOCUMENTATION:
In addition to an online user reference manual, printed copies of the LCOM Version 94B User Reference Manual are available upon request.

ALTERNATIVE/COMPARABLE APPROACHES:
None.

STAGE OF DEVELOPMENT:
The LCOM model was developed as a joint project between the Air Force and Rand Corporation in the late 1960's. It has been available for use since the early 1970's. The model is constantly being upgraded and enhanced. The latest enhancement is the incorporation of graphics by using the SIMGRAPHICS feature of the SIMSCRIPT compiler.

The LCOM simulation software, online and printed copies of the user manual, and sample data cases can be obtained from the points of contact:

Mr. Richard Cronk / Mr. Alan Wallace
USAF Aeronautical Systems Center
ASC/XRECR, 1970 Third St., Ste. 2
Wright-Patterson AFB, OH 45433-7401

Phone: 513-255-8060 / DSN: 785-8060
FAX: 513-476-7603 / DSN: 986-7603
E-mail: cronkra@xrease.wpafb.af.mil
or wallacaj@xrease.wpafb.af.mil

@DOMAIN:HFM

VALIDATION:
HQ Tactical Air Command (now Air Combat Command), "LCOM F-4E Field Test Final Report 15 Jan - 9 Mar 1973."

COMMENTS:
One of two sample data cases distributed with the LCOM software is the Joint Service Generic Fighter database. It illustrates the Joint Service

applicability of the LCOM simulation by modeling a fighter aircraft operated and maintained by Navy and Air Force units. The second sample data case distributed with the software is the LCOM Bicycle problem. It models a bicycle used on a newspaper route, and is an excellent training database. LCOM has been used extensively by the academic community. Twenty-five Masters Thesis projects using LCOM have been accomplished over the years.

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: Man-Machine Integration Design and Analysis Systems (MIDAS)

SPONSOR: NASA Ames Research Center
POINT OF CONTACT: Mr Jay Shively / 650-604-6249
RECORD NO.: HSI00028

GENERAL OVERVIEW:
MIDAS is an integrated suite of software components to aid analysts in applying human factors principles and human performance models to the design of complex human-machine systems. The goal of the program is to develop an engineering environment which contains tools and models to assist design engineers in the conceptual phase of rotorcraft crewstation development, and to anticipate crew training requirements. The MIDAS test bed serves to aid designers with predictive data on operability, levels of automation, and function allocation issues for human machine systems, and to support further research on human performance models.

APPROPRIATE USES:
MIDAS is intended to be used at the early stages of conceptual design as an environment wherein designers can use computational representations of the crew station and operator, instead of hardware simulators and man-in-the-loop studies, to discover first-order problems and ask "what if" questions regarding the projected operator tasks, equipment and environment for advanced vehicles. Although MIDAS is currently focused on helicopters, its model and principle basis permits generalization to other vehicles. In fact, interest in MIDAS has arisen from applications as diverse as the layout of nuclear power plant control consoles to the design of emergency response vehicles.

EQUIPMENT REQUIRED:
The MIDAS workstation is hosted on Silicon Graphics 4D Series workstations.

INPUTS REQUIRED:
MIDAS serves as a framework in which other research findings and models developed by or sponsored through the Computational Human Engineering Research Office are instantiated. Inputs vary for each model.

PROCESSING TECHNIQUES:
MIDAS contains tools to describe the operating environment, equipment, and procedures of manned systems, with models of human performance behavior used in static and dynamic modes to evaluate aspects of crew station design and operator task performance. Models of visual perception, attention, memory functions, rule-based and algorithmic decision making, task loading, and scheduling behavior are included. These models are encoded in an object-oriented architecture in which the individual models (as well as the system under study) are represented as interdependent agents that communicate with each other. The modular structure and strict communication protocol of this architecture allows MIDAS to support multiple representations of human performance at varied levels of detail. Thus, MIDAS is similar in concept to computational tools, such as finite element analysis and computational fluid dynamics, which are used to improve designs and reduce costs.

OUTPUT:
The MIDAS output is presented graphically and visually to the research psychologist or design engineer; often as a computer animation of "manned flight". Quantitative timeline and task workload is also available.

USES OF OUTPUT:
The output allows integration and visualization of human factors principles early in the conceptual phase of crew station design.

DOCUMENTATION:
MIDAS Phase V Detailed Design Document, TN-93-8216-000-3, Dec 1992.

ALTERNATIVE/COMPARABLE APPROACHES:
Other task modeling, workload, and rapid prototyping tools (such as Windex, Taul, MicroSAINT, and VAPS) can produce output similar to individual MIDAS components.

STAGE OF DEVELOPMENT:
The MIDAS program began in the fall of 1984 and has completed six major phases of development toward a 1995 target date for a full-prototype system. The current phase focuses on the expansion of several elements of the system demonstrated at a Cognitive Modeling Workshop in February 1994.

To obtain additional information, write: Mr. Barry Smith, Mail Stop 269-6, NASA-AMES Research Center, Moffett Field, CA 94035-1000.

VALIDATION:
Validation study is in progress. The report is expected to be completed in June 1995.

COMMENTS:
Models instantiated in MIDAS are described separately under names of "Dynamic Anthropometric Modeling (JACK)" and "Modeling of Cockpit Display Visibility".

OVERALL CATEGORY: Tool
STATUS: Available 1998

TITLE: Manpower, Personnel, and Training in Acquisition Decision Support System (MPTDSS)

SPONSOR: Air Force Research Laboratory
POINT OF CONTACT: Mr Larry T Looper / 210-536-2619, DSN: 240-2619
EMAIL: looper@alhrm.brooks.af.mil
RECORD NO.: HSI00079

GENERAL OVERVIEW:
The MPT DSS is an Air Force program designed to provide the first integrated tool for addressing MPT requirements during system acquisition and design. The MPT DSS is a micro-level tool that will help analysts build a credible baseline of measurable MPT acquisition goals and constraints, provide MPT inputs needed for system trade-off studies, allow analysts to study design alternative implications and verify whether the completed system achieved the MPT goals and constraints. This prototype focuses on enlisted maintenance specialties for tactical aircraft systems. The system will automate the extraction of historical MPT data from Air Force databases and new system data from the Logistics Support Analysis Record (LSAR). This historical data will be used to create a baseline comparison system. As new system information is received, a notional system configuration will emerge. Finally, a suite of MPT analysis methodologies and trade-off tools applied to the notional system will produce key MPT products needed to support the acquisition and design process, and establish the maintenance personnel and training pipelines.

APPROPRIATE USES:
To assist acquisition managers and analysts to effectively integrate people issues (numbers, characteristics, proficiency) with equipment (aircraft) early in the acquisition cycle. Acquisition specialists and MAJCOM planners can use the structured analysis approach provided by the MPT DSS to ensure that system-people costs are affordable, jobs are properly structured, and people are trained prior to the system's becoming operational. The MPT DSS is being designed to support the Human System Integration requirements contained in DODI 5000.2.

EQUIPMENT REQUIRED:
Pentium-based PC with 16 MB RAM, 1 GB disc storage (can be combination of Hard Disc and Removable Media), CD-ROM, Printer, and MS Windows 3.1

INPUTS REQUIRED:
- Work Unit Code-based description of aircraft components;
- Maintenance Data Collection System Data on predecessor aircraft;
- Occupational description and tasks performed on Air Force Specialties supporting the predecessor aircraft;
- AFR 173-13 data downloaded from the AF Cost Center's free bulletin board;
- Logistics Composite Model on predecessor aircraft is optional.

PROCESSING TECHNIQUES:
Self-extraction routines are being built to read Reliability Enhanced Maintenance Information System (REMIS) information, Logistics Composite Model networks, and data from the AFR 173-13 database. All other inputs are manually entered at this time.

OUTPUT:
- Baseline Comparison System description (LSA task 203);

- Unit manpower estimates (scenario-based);
- Specialty (occupation) structuring with aptitude requirements;
- Training resource requirements;
- Force manpower estimates;
- MPT plans;
- MPT life-cycle costing; Manpower Estimate Reports;
- Trade-off analyses results and comparisons.

USES OF OUTPUT:
Manpower Estimate Report can be used directly to submit manpower requirements to AF/MO and Defense Advisory Boards. Baseline Comparison System can be used as system description for LSA task 203. Specialty structures can be used to modify existing, or create new, Air Force occupations. Training resource requirements forecasts can be used in training planning. MPT life-cycle costing can be used to validate the MPT portions of the Cost and Operational Effectiveness Analysis (COEA) reports generated by contract sources. Other trade study results generated by the analysis methodologies can be used in support of weapon system design trades and included in the Integrated Program Summary for Human Systems Integration.

DOCUMENTATION:
None applicable.

ALTERNATIVE/COMPARABLE APPROACHES:
Technologies supporting the Army's MANPRINT and Navy's HARDMAN programs.

STAGE OF DEVELOPMENT:
6.3A Advanced Technology Demonstration Program. Software tailored to the needs of the Joint Strike Fighter Program Office. POC: Mr. Tim Bookwalter, 703-416-3043.

VALIDATION:
Completed Jan., 1998.

COMMENTS:
Software is complex. Addresses multi-domain effects of changing manpower profiles and its impacts on the occupational structure and training requirements and vice versa. Users are expected to receive additional training from the developing contractor or Air Force laboratory personnel to be able to use the software.

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: Micro Saint with Action View (Systems Analysis of Integrated Networks of Tasks)

SPONSOR: Micro Analysis and Design, Inc
POINT OF CONTACT: Ms Catherine Barnes / 303-442-6947
EMAIL: cbarnes@maad.com
RECORD NO.: HSI00034

GENERAL OVERVIEW:
Micro Saint is a discrete-event task network modeling tool. It is easy to use, and is designed to be used by anyone who has a knowledge of the system that needs to be analyzed.

APPROPRIATE USES:
Micro Saint can be used to analyze and improve any system that can be described by a flow diagram. It can be used to answer questions about the costs of alternative training, about how crew workload levels or reaction times affect system performance, and about the allocation of functions between people and machines.

EQUIPMENT REQUIRED:
Micro Saint requires an IBM-compatible microcomputer with MicroSoft Windows and 16 MB RAM.

INPUTS REQUIRED:
Micro Saint requires the following inputs: (1) a list of the tasks in the system; (2) estimates of the mean and standard deviation of the performance times; (3) the sequence and branching logic of the tasks; and (4) any resources that are consumed, processed, or generated by each task. System-specific information that affects the performance of the system being modeled also can be entered (e.g., environmental data).

PROCESSING TECHNIQUES:
Micro Saint executes a discrete event simulation model. This model uses the stochastic branching logic, task interactions, and performance estimates to generate results that predict the range of system outputs. This analysis is difficult and time consuming to do by hand, due to the stochastic nature of most systems.

OUTPUT:
Micro Saint automatically outputs task timelines, graphs, and tables of system performance statistics. Automatic data collection is provided for queues. Users can also generate statistics on any variable they have added to the system (e.g., resource utilization, skill acquisition, workload level).

Micro Saint output can be exported to other application programs for additional processing, and is contained in an ASCII file for incorporation into word processing documents.

USES OF OUTPUT:
The outputs can be used to answer questions about how the system will perform under a variety of conditions. Users can build models in Micro Saint that help predict the effect of changes to a system before committing resources to implement the change. The models can also be used to conduct a sensitivity analysis on the variables in the system.

DOCUMENTATION:
Bolin, S.F., Nicholson, N.R., and Smootz, E.R., "Crew Drill Models for Operational Testing and Evaluation," Paper presented at MORIMOC II Conference, Military Operations Research Society, Alexandria, VA, 22 Feb 1989.

Dahl, S.G., Drews, C.W., Kelly, K.J., and Plott, C.C., "MicroSAINT: A Simulation Tool for the Human Factors Professional," Computer Systems Group Bulletin, Vol. 14, No. 1, March 1987.

Tijerina, L. and Treaster, D., "MicroSAINT Modeling of the Close-in Weapon System (CIWS) Loading Operation: Internal Validation and Sensitivity Analysis," Paper presented at MORIMOC II Conference, Military Operations Research Society, Alexandria, VA, 22 Feb 1989.

ALTERNATIVE/COMPARABLE APPROACHES:
The core of Micro Saint is embedded in the Army Research Laboratory's HARDMAN III products, in the Human Operator Simulator (HOS V), and in the Integrated MANPRINT Tools (IMPRINT). A version of the engine is embedded in the software for the Army Research Laboratory's Crew Reduction in Armored Vehicles Ergonomic Study (CRAVES). Additionally, Micro Saint's engine is included in the Air Force's Manpower, Personnel, and Training Decision Support System (MPTDSS).

STAGE OF DEVELOPMENT:
Enhancements are added anually. New versions are available to government users at a cost. To obtain, contact: Ms. Catherine Barnes, Micro Analysis and Design, Inc., 4900 Pearl East Circle, Ste. 201E, Boulder, CO 80301. Phone: (303) 442-6947; Fax: (303) 442-8274; E-mail: sales@maad.com.

COMMENTS:
"Animation" and "Action View" are companion products that display the model as it runs. Training and technical support are available.

OVERALL CATEGORY:	Tool
STATUS:	Available

TITLE: The Observer

SPONSOR: Noldus Information Technology, Inc
POINT OF CONTACT: Mr Bart Van Roekel / 1-800-355-9541
EMAIL: info@noldus.com
RECORD NO.: HSI00168

GENERAL OVERVIEW:
The Observer is a professional system for collection, analysis and management of observational data, and for 'live' data entry by a human observer, or from video tape, using a desktop or hand-held computer. The Observer is the ultimate system for the collection, analysis, presentation and management of observational data. It can be used to record activities, postures, movements, positions, facial expressions, social interactions, or any other aspect of human or animal behavior.

APPROPRIATE USES:
Human ergonomics studies: task analysis, labor and time studies, efficiency research, man-machine interfaces, human-computer interaction.

EQUIPMENT REQUIRED:
486 CPU or higher; Windows 95 or NT; 8 MB RAM; 10 MB hard drive; VCR, if working from video; MPEG encoder, if working with digital video files; optional: video recorder with serial interface, video overlay board (can be purchased from Noldus Information Technology, Inc.)

INPUTS REQUIRED:
Designed for data entry by a human observer, The Observer is the logical successor of paper and pencil. You can enter data directly into a PC or hand-held computer, or code events from video tape or digital media file. No more time-consuming and error-prone data transcription -- analysis reports are available instantly. These supply you with objective and quantitative data for direct conclusions or further research.

PROCESSING TECHNIQUES:
Once data collection has been completed, powerful analysis options are only a few keystrokes away. You can explore your data in time-event tables and plots, or generate reports with statistics on frequencies and durations, the sequential structure of the process, or the co-occurrence of events. Results can be displayed onscreen, printed on paper, or saved in a file on disc.

OUTPUT:
For additional calculations and inferential analysis (hypothesis testing), you can export the summary tables to spreadsheets, databases, or statistics packages. The Observer formats the output for the package of your choice. When working with video, the system can create highlight tapes.

USES OF OUTPUT:
Presentation of numerical data for export to spreadsheet or statistical package; direct use in reports.

Hours of training required: 16

DOCUMENTATION:
Extensive user manual comes with software.

ALTERNATIVE/COMPARABLE APPROACHES:
Pencil and paper

STAGE OF DEVELOPMENT:
Version 4.0

VALIDATION:
N/A

COMMENTS:
See Website: http://www.noldus.com/products/observer/obs_biblio.htm

For more information contact: Bart van Roekel
Noldus Information Technology, Inc.
6 Pidgeon Hill Dr., Ste 180
Sterling, VA 20165
Voice: 703-404-5506

OVERALL CATEGORY: Tool
STATUS: Available 1998

TITLE: Operational Requirements-Based Casualty Assessment System (ORCA)

SPONSOR: Army Research Laboratory (Survivability/Lethality Dir) Directorate
POINT OF CONTACT: Mr David N Neades / 410-278-6335, DSN: 298-6335
EMAIL: dave@arl.mil
RECORD NO.: HSI00102

GENERAL OVERVIEW:
The Operational Requirements-Based Casualty Assessment System (ORCA) model provides new methodology for assessing the anti-personnel effects associated with various munitions-produced damage mechanisms. This model is the product of the Crew Casualty Working Group, a joint Army, Navy, Air Force project under the JTCG/ME & JTCG/AS organizations. Development of this model was prompted by concern for computation of user casualties.

The Crew Casualty Project was tasked to produce a methodology and computer code to evaluate personnel casualties: 1) for all (conventional) insults (blasts, burns, bullets, etc.); 2) for any crew position (pilot, gunner, infantry, etc.); and 3) consistent with the needs of the medical community.

The assumptions, constraints, and salient features were: 1) the problem begins at "the skin"; 2) operational casualties only; 3) no medical treatment; 4) no motivational effects; and 5) strong reliance on adaptation of existing models.

The ORCA model combines the best features of several existing models, and combines them in a way that allows consistent assessment of casualties across virtually all platform, job, and threat types. ORCA is an automated, interactive model with which conditions can be changed "on the fly" to assess various outcomes.

APPROPRIATE USES:
The ORCA computer code allows one to calculate anatomical damage and the effect on individual performance of exposure to kinetic energy (fragment), thermal, chemical, directed-energy (laser), blast, and accelerative loading threats. In each case, the effect of a computed injury is characterized by the predicted impairment of each of 24 human elemental capabilities (e.g., vision, cognition, and physical strength). Post-injury capability is then compared to capability requirements associated with the individual's military job, task, or mission to determine whether he/she is an operational casualty. Code outputs for discrete exposures (e.g., a single-fragment impact) include a physical damage summary, details of any deleterious processes (e.g., blood loss), AIS score, elemental capability status, and remaining performance capability (comparable to incapacitation) as a function of time after wounding (six time periods ranging from immediate to 72 hours). In addition to discrete simulations with single threats, ORCA can also be run in GRID or batch mode to produce results that reflect a range of exposure conditions.

EQUIPMENT REQUIRED: Unix machine.

INPUTS REQUIRED:
The ORCA code allows the user to specify the operational requirement for a military job, task, or mission by selecting from a library of 18 military occupations (MOS, NEC, or AFSC), specific military tasks, or predefined

mission scenarios. Users can also build a customized requirement with assistance from the available task library.

PROCESSING TECHNIQUES:
ORCA's casualty assessment process is depicted below.

```
                                     INSULT
                                       |
          INDIVIDUAL                   |
       CHARACTERIZATION                v
               |
               |                     INJURY
               |                    (A)  (B)
               v                    /      \
                                   /        \
        MOS/NEC/AFSC         ELEMENTAL      MEDICAL
            TASK             CAPABILITY     ASSESSMENT
        REQUIREMENTS           X(t)             |
               |                |               |
               |                |               |
               v                v               v

        ELEMENTAL     ->     COMPARE           MEDICAL
        CAPABILITY         REQUIREMENTS        CASUALTY
        REQUIREMENTS            TO             (YES/NO)
             Z              IMPAIRMENT
                                |
                                |
                                v

                       OPERATIONAL CASUALTY
                             (YES/NO)
```

OUTPUT:
Results are displayed on the screen. Data includes: description of anatomical damage and associated deleterious processes; post-injury capabilities broken down into 24 discrete areas (e.g., night vision, psychomotor mental processing, arm/hand dexterity, etc.), and residual performance at 6 post-injury time frames (immediate, 30 sec., 5 min., 1 hr., 24 hrs., 72 hrs.).

USES OF OUTPUT:
Ability to assess the immediate and longer-term capabilities of an operator, and the level of injury caused by the initial result. This, in turn, can be used in assessing munition effectiveness, protective equipment needs, medical field unit and battle planning, as well as war gaming simulations. The model can be used in a stand-alone, high-resolution mode to examine specific single-event exposures, or offline to generate output databases which will lead to generalized correlation curves.

DOCUMENTATION:
The code provides extensive online help, and will be supported by a User's Guide and Technical Manual when released.

ALTERNATIVE/COMPARABLE APPROACHES:
ORCA predecessor models include: ComputerMan (USA); Cheman (USA - now a module in ORCA); INJURY (USA); Articulated Total Body (USAF); and BURNSIM (USAF)

STAGE OF DEVELOPMENT:
Alpha Version 2.08; beta version in test; beta version available at the end of 1997.

VALIDATION:
Two validation efforts are currently in progress. Both will involve the use of expert panels to review the overall methodology, as well as the data and algorithms incorporated in ORCA. Two additional efforts are planned for 1998, which will address the validation of the military job/task/mission information, as well as the Injury-to-Impairment mappings.

COMMENTS:
Alternate POC: Mr. J. Terrence Klopcic
410-278-6322 / DSN 298-6322 / FAX 410-278-4684
CREWCUT features many output and analysis features, and allows the user to develop new missions or copy them from the library. CREWCUT includes extensive on-line help.

Versions of CREWCUT are available for the Sun workstations and Silicon Graphics workstations. However, these versions are not fully supported.

CREWCUT user documentation is available. For information, contact the POC.

A Windows version of CREWCUT is under development, and will be called "WINCREW".

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: Operator Workload Knowledge-Based Expert System Technology (OWLKNEST)

SPONSOR: Army Research Institute
POINT OF CONTACT: Dr Richard E Christ / 254-286-6946, DSN: 566-6946
EMAIL: christ@ari.army.mil
RECORD NO.: HSI00036

GENERAL OVERVIEW:
OWLKNEST is a microcomputer-based methodology that guides selection of the appropriate techniques for assessing Operator Workload (OWL) in developing Army systems. It is based on knowledge from ARI's OWL program.

APPROPRIATE USES:
This method has potential impact on tradeoff studies involving all the MANPRINT domains. The method is applicable across all phases of the materiel acquisition process.

EQUIPMENT REQUIRED:
OWLKNEST requires an IBM-compatible PC with 640 Kb memory and DOS 2.0 or higher. A run-time version of Exsys Professional, an expert system shell, is included.

INPUTS REQUIRED:
OWLKNEST assumes that the users have fundamental knowledge of OWL concepts; however, they can be computer novices. A question-and-answer dialogue, supplemented by embedded help features, drives user input to OWLKNEST. Input consists of requirements and system characteristics related to prospective system operators.

PROCESSING TECHNIQUES:
The expert system applies rules and knowledge provided by workload domain experts. OWLKNEST knowledge is organized based upon a taxonomy that divides OWL techniques into analytical and predictive techniques, which can be applied early in the system design, and empirical techniques, which are applied later when an operator is in the loop during simulator, prototype, or system evaluations.

OUTPUT:
The output of OWLKNEST is a list of OWL techniques with a ranking of high, average, or low applicability. The rankings are based on cumulative probabilities that the system builds with each question answered by the user. The user also can obtain one-page descriptions of the recommended techniques including implementation requirements, references, and points of contact.

USES OF OUTPUT:
The outputs of OWLKNEST serve as a guide to indicate the order in which the user should consider applying the techniques. The user can optionally access the rules to see what parameters were influential in the determination of the ranking of techniques, and hence gain insight on the appropriateness of the OWL techniques at different points throughout the materiel development cycle. OWLKNEST also can be used in a sensitivity analysis mode by changing one or more responses given. In this mode, the user will be provided with information on which to base decisions as to whether additional resources should be allocated to the OWL assessment effort.

DOCUMENTATION:
Harris, R.M., Hill, S.G., Lysaght, R.J., and Christ, R.E., "Handbook for Operating the OWLKNEST Technology (HOOT)," ARI Research Note 92-49, U.S. Army Research Institute for the Behavioral and Social Sciences, Alexandria, VA.

ALTERNATIVE/COMPARABLE APPROACHES:
Hart, S.G., Shively, R.J. and Casper, P.A., "Workload Consultant for Field Evaluation (WC FIELDE)," Moffett Field, CA: NASA Ames Research Center, 1988.

STAGE OF DEVELOPMENT:
Mature. To obtain, ARI will provide a floppy disk of the software as a research product (to accompany the published user's manual -- see the first reference) to be distributed through the Defense Technical Information Center (DTIC). Copies of the method may be obtained from: Chief, ARI Field Unit, Attn: PERI-RK (Dr. R.E. Christ), P.O. Box 3407, Ft. Leavenworth, KS 66027-0347.

COMMENTS:
None.

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: Perception and Performance Prototype (P3)

SPONSOR: Air Force Research Laboratory
POINT OF CONTACT: Dr Don Monk / 937-255-8814, DSN: 785-8814
RECORD NO.: HSI00037

GENERAL OVERVIEW:
Perception and Performance Prototype (P3) is a human factors information resource for design engineers. It is an Apple Macintosh-based multi-document engineering database on CD-ROM, which includes the Engineering Data Compendium, and MIL-STD-1472-D.

APPROPRIATE USES:
P3 allows users to electronically access the complete text and graphics of these two human performance information sources in an effort to integrate that information with their engineering design efforts. The goal of the Perception and Performance Prototype is to achieve a match between operator characteristics and specifications for all types of military and industrial systems.

EQUIPMENT REQUIRED:
Equipment required for use involves Apple Macintosh II with 13" monochrome display (color is preferable), 2 MB memory, 2 MB available hard drive space, and a CD-ROM drive.

INPUTS REQUIRED:
The system is self-contained, but other data may be imported inro some P3 modules, allowing the user to interact with supplied data to be compared with the on-line reference data.

PROCESSING TECHNIQUES:
Internally developed demonstrations and interactive experiments are available for first-hand experiencing of many human behavioral phenomena that are discussed in the two reference base documents. Within each independent module, various parameters can be set to interactively explore the range of phenomenon variables. Modules are linked to relevant entries in the reference base so that the user can acquire a deeper understanding of the experiential data.

OUTPUT:
P3 provides relevant information of interest to the design engineer. It can also be used as a means to explore human behavioral phenomena. Several of the P3 modules save experimental results and settings to a text file for use in post-processing appications.

USES OF OUTPUT:
The output P3 text files can be imported into analysis applications for further processing of experimential human performance data.

DOCUMENTATION:
Computer-Aided Systems Human Engineering: Performance Visualization System - Users Guide

ALTERNATIVE/COMPARABLE APPROACHES:
None known.

STAGE OF DEVELOPMENT:
Available. To obtain, write: Dr. Don Monk, AFRL/HECA, Bldg. 248, 2255 H St., Wright-Patterson AFB, OH 45433-7022.

COMMENTS:
P3 is a separate application of, and also incorporated into, the CASHE program (see HSI00010).

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: Reliable Human-Machine System Developer (REHMS-D)(tm)

SPONSOR: KPL Systems
POINT OF CONTACT: Dr Kenneth P LaSala / 301-625-9457
EMAIL: kplsys@prodigy.net
RECORD NO.: HSI00188

GENERAL OVERVIEW:
The Reliable Human-Machine System Developer (REHMS-D)(tm) is a major advance in system and reliability engineering that has broad application to systems and processes. REHMS-D uses a six-stage system engineering process, a cognitive model of the human, and operational sequence diagrams to assist the designer in developing human-machine interfaces subject to top-level reliability or yield requirements. Through its system engineering process, REHMS-D guides the designer through the understanding of customer requirements, the definition of the system, the allocation of human functions, the basic design of human functions, the assignment of job aids, and the design of tests to verify that the human functions meet the allocated reliability requirements. REHMS-D can be used for both the synthesis of new systems and the analysis of existing systems.

APPROPRIATE USES:
System and process designers can apply REHMS-D to many subjects. For example, REHMS-D can be used to synthesize or analyze radar and sonar systems, control rooms and control systems, communications systems, geographic information systems, manufacturing processes, maintenance processes, biomedical systems, transportation systems, and other systems and processes that involve human-computer interfaces.

EQUIPMENT REQUIRED:
Personal computer, Windows 3.X or Windows 95, mouse.

INPUTS REQUIRED:
Data on: situational characteristics -- illumination, atmospheric conditions, temperature, pressure, humidity, ambient noise, motion/vibration; and on psychological stressors -- taskload, task duration, skill level.

PROCESSING TECHNIQUES:
Uses reliability as a metric for selection of human interface and task parameters.

OUTPUT:
Screen-displayed analysis results.

USES OF OUTPUT:
REHMS-D includes the following features to assist designers in obtaining high levels of reliable human performance: operational sequence diagrams for rapid system or process visualization; online help in selecting environments and interface characteristics, warning when safe levels areexceeded; two levels of sensitivity analysis to allow identification of opportunities for improvement; choices for types of inputs to the operator and responses by the operator; and graphical displays of test plans. When the user desires, REHMS-D creates interface specifications for selected human functions.

DOCUMENTATION:
The REHMS-D software includes online help screens. REHMS-D is sold with a

printed user manual that describes both the overall REHMS-D concept and the detailed procedures for using REHMS-D. A one-day training course is available.

ALTERNATIVE/COMPARABLE APPROACHES:
There are no other computer-based decision support products like REHMS-D. No other product provides human performance reliability-oriented decision support as the user proceeds from establishing system requirements through design and test.

STAGE OF DEVELOPMENT:
REHMS-D is available commercially as REHMS-D Version 1.1. A limited number of beta site licenses are available at a reduced price to support future development.

VALIDATION:
The validation subject for REHMS-D was the circuit board manufacturing process of a major U.S. electronics manufacturer. REHMS-D predictions were compared with process performance data. The validation was useful to the manufacturer because it showed how the process yield could be increased by changes that improved human performance in process tasks.

COMMENTS:
REHMS-D may be obtained under license under a standard commercial agreement, or may be obtained at a reduced price under a beta site agreement. More information about REHMS-D can be found at the following World Wide Web site: http://pages.prodigy.com/TWBT41B/rehms1.htm

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: SAFEWORK(tm)

SPONSOR: GENICOM Consultants, Inc
POINT OF CONTACT: Mr Robert Carrier / 514-931-3000
EMAIL: robert@safework.com
RECORD NO.: HSI00130

GENERAL OVERVIEW:
SAFEWORK(tm) is a 3-D design analysis software for analyzing the interaction between humans and their workspace. This powerful man-modeling tool quickly creates virtual male or female mannequins of various percentiles, based on U.S. Army statistics, that the user can adjust to accommodate critical variables or a targeted percentage of the population. The software is designed to resolve a majority of ergonomic problems during the design stage.

APPROPRIATE USES:
SAFEWORK(tm) creates humans of various percentiles to study fit and accessibility in a workspace. The software permits generation of mannequins using percentiles or absolute values for up to 103 anthropometric variables. The unspecified variables are calculated automatically with a statistic-based algorithm. Numerous forms of analysis can be done, including postural analysis, reach, and access studies, along with a sophisticated vision module for sight analysis. Through the animation module, users can simulate tasks and optimize the work involved within the environment.

EQUIPMENT REQUIRED:
Any Silicon Graphics workstation running IRIX 5.3 or greater; 24-bit color plane.

INPUTS REQUIRED:
Using the SAFEWORK(tm) file parser, users import their CAD designs from a host CAD system. Most file formats are accepted, including IGES, OBJ, DXF, COOR, and SWX. The user then defines the critical variables necessary to analyze the design, and simulates the mannequins' activities within the environment to ensure optimal functioning.

PROCESSING TECHNIQUES:
The program uses MOTIF to create a multiple-windows environment with standard graphics interface. Mannequins can be represented using links, ellipses, lines, and flat and Gouraud shading. Mannequin sex and morphological profile can also be specified, including seven somatotypes from ectomorphs to mesomorphs.

SAFEWORK(tm) mannequins are generated by using multi-normal modeling techniques. Upon user's inputs of critical variables, a special boundary mannequin algorithm unique to SAFEWORK(tm) automatically adjusts all other anthropometric variables based on statistical correlations. This process assures the user that the desired percentage of the population is accommodated, and that the mannequins do exist in the population.

Mannequin movement is performed using Direct or Inverse Kinematics. Seven Inverse Kinematics handles control of the movement of the mannequin, and predicts the natural motion behaviour. The Direct Kinematics mode consists of 99 independent links and 148 degrees of freedom, which takes into account the limits of joint mobility, and supports coupled range-of-motion. Included

in the mannequin's movement are a fully articulated hand and spine model.

OUTPUT:
The SAFEWORK(tm) interface consists of windows and pop-ups, along with a tool and status bar. The SAE's standard male and female percentile mannequins are used as the default. Any changes or adaptations to these mannequins are processed through the various modules:

Anthropometry Module: A pop-up that accesses 7 different morphological profiles and allows the user to define up to 103 anthropomentric variables on the mannequin. These variables can be altered manually by inputting desired measurements in percentiles, unit measurements, or by a click-and-drag system. It also has the capacity to define the Mean and Standard Deviation based on the measurements entered.

Postural Analysis: A pop-up that permits the user to analyze posture, find postural scores, set functional limitations and range of motion, and analyze optimal comfort and positioning.

Vision Module: This module displays the mannequin's vision based on data taken from NASA 3000 studies. Four types of vision are available: binocular, ambinocular, and monocular left and right. The window also displays peripheric cones, blind cones, central cones, central spot, blind spot and line of sight. Furthermore, adjustable fields-of-view and distance attributes are incorporated.

Animation: Once the mannequin is properly positioned within the environment, the sequence of tasks can be animated to preview any trouble spots or major obstacles.

Collision Detection: By switching on Collision Detection, users can analyze at which point contact is made with surrounding objects without having to do so visually.

USES OF OUTPUT:
Acting as a Virtual Mockup, SAFEWORK(tm) allows the user to analyze the mannequins' ability to function within the imported CAD design, and perform the closest form of customization for all future users of the final design.

DOCUMENTATION:
Documentation on SAFEWORK(tm) can be found in the form of a user's manual, along with a Basic and Advanced Training manual.

ALTERNATIVE/COMPARABLE APPROACHES:
N/A

STAGE OF DEVELOPMENT:
Having been functional for several years, SAFEWORK(tm) is continually evolving to reach market needs. Upcoming versions will include a highly defined surface modeling entitled, "Dual Krigeage".

COMMENTS:
For general information on SAFEWORK(tm), please contact Andrew Wozny (Sales & Marketing Representative) at the same POC address specified above.

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: Ship System HSI, Affordability, & Performance Engineering (SHIPSHAPE) Tools

SPONSOR: Carlow International, Inc
POINT OF CONTACT: Dr Thomas B Malone / 703-698-6225
EMAIL: tbmalone@carlow.com
RECORD NO.: HSI00143

GENERAL OVERVIEW:

The Ship System HSI, Affordability, & Performance Engineering (SHIPSHAPE) tool set is an adaptation of the Army's IDEA tool set for Naval and commercial ships and maritime systems. SHIPSHAPE is a set of automated processes, tools, and databases developed specifically to enable HSI analysts in the Navy and in the commercial shipbuilding and maritime system arena to meet HSI requirements as contained in the DoD 5000 series, Naval Sea Systems Command Instruction 3900.8, and ASTM-1166. The guiding principle behind the design of the SHIPSHAPE software is that the HSI analyst should have at his or her fingertips all of the guidance, instructions, processes, procedures, methods, tools, and data needed to conduct a timely and complete HSI effort. The elements of the SHIPSHAPE system are: the HFE process for ships; an integrated HFE information system; automated HFE tools; and a report generator for producing HFE plans and reports. The SHIPSHAPE tool set includes:

a) a SHIPSHAPE HSI Process Tool
b) a Comparability Analysis (I-CAN) tool which supports the identification of high-driver tasks/conditions and lessons learned from predecessor systems
c) a Role-of-the-Person (ROPER) tool which supports function allocations and determination of alternate feasible roles of the human
d) a Task Analysis (I-TASK) tool based on MIL-H-46855 and MIL-STD-1478
e) a functional flow/task sequencing tool, designated NETWORK, for graphically establishing the relationships among functions and tasks
f) a Simulation for Workload Assessment and Modeling (SIMWAM) tool for assessing multi-operator task network impacts on human performance and workload
g) a Tradeoff Analysis (ITALIC) tool to support the evaluation of alternative approaches, and assessment of alternatives on each criterion measure
h) a Safety and Health Hazard Analysis Determination and Evaluation (I-SHADE) tool to identify and track hazards, and develop hazard resolution plans
i) a Human Factors Engineering Data Guide for Evaluation (I-HEDGE) tool to support the selection, evaluation, and production of design checklists
j) an HSI Planning (I-PLAN) tool which supports planning an HSI or MANPRINT effort by tracking project tasks, personnel hours, task status, and deliverables with due dates
k) Carlow's Usability Test Tool for Evaluation and Research (CUTTER), which offers the following three modules to support all phases of usability testing: 1) a test preparation and planning support module; 2) a data-logging and data analysis module; and 3) an interface evaluation guideline module
l) a hypertext version of ASTM-1166

APPROPRIATE USES:
The tool has application throughout the ship/system design process. In the front-end conceptual design phase, the SHIPSHAPE tool addresses: 1) analysis

and integration of requirements, from mission requirements through function requirements, to task performance requirements; 2) allocation of function and determination of the role of the human vs. automation in performance of system functions; 3) development of alternate concepts for human-system interaction; 4) conduct of task network simulation to assess workload and human performance requirements for alternative design concepts, and identification of manning levels associated with each concept; and 5) assessment of the affordability and risk potential associated with each design approach. In the preliminary design phase, the SHIPSHAPE tool is directed toward developing design requirements and prototyping and assessing alternate human-machine interface (HMI) approaches and strategies. In the detail design phase, the SHIPSHAPE focus is in design and evaluation of HMI elements.

EQUIPMENT REQUIRED:
See individual tool descriptions (this Section). The SHIPSHAPE suite of tools is currently being ported from Macintosh to Windows machines.

INPUTS REQUIRED:
Inputs to an HFE analysis and design effort.

PROCESSING TECHNIQUES:
Processes and tools are written in HyperCard for Macintosh, and Tool Book for Windows.

OUTPUT:
Reports and data resulting from analysis, design, and evaluation activities.

USES OF OUTPUT:
In conceptual design, the output includes results of mission and function analysis, roles of humans vs. automation, and required manning levels for the ship/system. These outputs are used to specify the level of automation, required roles of the human, and requirements to support these roles, and numbers and qualifications of personnel to man the ship/system. In the preliminary design phase, outputs are used to further define the roles and requirements of human performance, particularly as it interacts with automated performance. In detail design, outputs include design criteria and specifications for human-machine interfaces, training systems, user documentation, information systems, and system safety design requirements.

DOCUMENTATION:
Each tool in the SHIPSHAPE tool set has a corresponding user's guide.

ALTERNATIVE/COMPARABLE APPROACHES:
There is no tool set comparable to the SHIPSHAPE Tool Set. However, there are alternatives to individual SHIPSHAPE tools, such as Micro-Saint simulation tool, which performs some of the functions of SIMWAM, and several task analysis tools which are comparable to I-TASK.

STAGE OF DEVELOPMENT:
Completed for all phases of the acquisition process.

VALIDATION:
The SHIPSHAPE tool set was most recently validated on the efforts to reduce manning on the Fast Sealift Ship, Seawolf Fast Attack Nuclear Submarine, New SSN, Surface Combatant 21st Century (SC 21) Ship,Autonomic Ship, Arsenal Ship, Smart Ship, DDG-51 Ship, LSD-41 Ship, LHA PRI-FLY, CVNs, CV air operations systems, CVX, CIC systems, engineering control/automated auxiliaries, waste management systems, reduced manning bridge, Integrated

Survivability Management System, Total Ship Survivability Training System, and DDG-51 accommodation of women program.

COMMENTS:
The SHIPSHAPE tool set, developed initially for the U.S. Navy, is being adapted for application in the offshore/commercial marine industry. The major thrusts of the commercial applications are in reduction of manning, and reduction of the incidence and impact of human error in maritime systems. An example of the tailoring of SHIPSHAPE tools to the commercial maritime industry was seen in the workshop entitled "Human Error Reduction through Human and Organizational Factors in Design and Engineering of Offshore Systems", conducted in the 1996 International Workshop on Human Factors in Offshore Operations, New Orleans, Louisiana.

Following is a list of recent publications describing the SHIPSHAPE tool set and specific applications:

Anderson, David E., Malone, Thomas B., and Baker, C.C. (1996). "Impacts of Reduced Manning on System Reliability and Maintainability", professional paper accepted for publication and presentation at the American Society of Naval Engineers.

Anderson, David E., Oberman, Frederick, Malone, Thomas B., and Baker, C.C. (1996). "Influence of Human Engineering on Manning Levels and Human Performance on Navy Ships", Proceedings of the American Society of Naval Engineers.

Bost, J.R., Baker, C.C., Heasly, C.C., and Malone, T.B. (1996). "Technology and People: Striking a Balance", Marine Log Conference on Marine Technology.

Malone, T.B., Baker, C.C., Anderson, D.E., Bost, J.R., McCafferty, M. Jennings, Noreager, J., and Terry, E. (1996). "Human Error Reduction through Human and Organizational Factors in Design and Engineering of Offshore Systems", 1996 International Workshop on Human Factors in Offshore Operations, New Orleans, LA.

Malone, Thomas B., Baker, C.C., Bost, J.R., and Anderson, David E. (1996). "Human Systems Integration in Navy Ship Manpower Reduction", Proceedings of the 40th Annual Meeting of the Human Factors and Ergonomics Society, Philadelphia, PA.

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: SHIPSHAPE Human Systems Integration (HSI) Process Tool

SPONSOR: Carlow International, Inc
POINT OF CONTACT: Dr Thomas B Malone / 703-698-6225
EMAIL: tbmalone@carlow.com
RECORD NO.: HSI00145

GENERAL OVERVIEW:
The SHIPSHAPE Human Systems Integration (HSI) Process Tool is a graphic presentation of the activities associated with applying HSI at each phase of ship/system acquisition. The SHIPSHAPE HSI process architecture has the following characteristics:

- it is integrated with the activities, products, and requirements for each phase of the ship acquisition process
- it defines and describes HSI activities, events, inputs/outputs, products, and methods for each ship acquisition process phase, and provides guidelines on the application of the activities and methods, and on the contents and format of the products
- it provides a help facility to further assist the analyst in tailoring the process to the specific system under acquisition
- it incorporates the tools required to apply the HSI methods, and to accomplish the HSI activities, and provides access to any tool from any point in the process
- it is focused on personnel readiness and effectiveness requirements
- it addresses the development of a new system, a non-development item (NDI), or product improvement
- it provides a formal mechanism for getting HSI issues and concerns addressed early in ship acquisition.

The process currently consists of 70 individual steps over the 6 phases of ship acquisition, at up to 5 levels of decomposition.

APPROPRIATE USES:
The process comprises the basis for HSI planning activities, identification and tracking of HSI issues, conduct of individual HSI activities, and application of SHIPSHAPE tools.

EQUIPMENT REQUIRED:
The process is a Hypertext graphic written in HyperCard for the Apple(r) Macintosh or IBM PC compatibles. Macintosh version requires System 6.0 or higher and HyperCard 2.1 or later. PC version requires Windows 3.1 or higher, and Tool Book for Windows.

INPUTS REQUIRED:
Requirements to tailor the standard IDEA process to the specific system acquisition.

PROCESSING TECHNIQUES:
Inherent in HyperCard and Tool Book.

OUTPUT:
Guidelines on performance of specific HSI activities in the context of ship acquisition.

USES OF OUTPUT:
Products of specific HSI activities.

DOCUMENTATION:
SHIPSHAPE Human Systems Integration (HSI) Process Tool User's Guide.

ALTERNATIVE/COMPARABLE APPROACHES:
The IDEA HSI/MANPRINT Process Tool, and the Human Factors in Acquisition Requirements identification Process (HARP), developed by Carlow International for the FAA Human Factors Office, and available on the World-Wide Web.

STAGE OF DEVELOPMENT:
Completed and fully operational in HyperCard and Tool Book, and will be ported to HTML for the Web.

VALIDATION:
Validated on the reduced manning of the Fast Sealift Ship, Seawolf Fast Attack Submarine, New SSN, SC-21 Ship, Autonomic Ship, Arsenal Ship, Smart Ship, DDG-51 Ship, LSD-41 Ship, LHA Ship, CVNs, CV air operations systems, CIC systems, waste management systems, reduced manning bridge, automated ship auxiliaries, and DDG-51 accommodation of women program.

COMMENTS:
Application of the HSI process to ships must address the following: 1) personnel considerations and requirements must influence system design; 2) HSI must have a central role in the affordability assessment; 3) HSI must drive the system risk assessment; 4) HSI must maximize the quality of acquired products; 5) HSI must attend to requirements for concurrent engineering; 6) the HSI process must address the emphasis on use of commercial products and standards; 7) the HSI process must include requirements for prototyping, simulation, and modeling; 8) HSI must include requirements for specifying system operational performance objectives; 9) HSI must provide methods and data to enable manning reduction and to ensure adequate safety and workload in a reduced-manning environment; 10) HSI must address the man-machine interface design requirements specific to a ship acquisition; and 11) HSI must provide methods and data to identify training requirements and curricula changes associated with a reduced-manning environment.

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: SHIPSHAPE Hypertext Tool for ASTM-F-1166 (HT-1166)

SPONSOR: Carlow International, Inc
POINT OF CONTACT: Dr Thomas B Malone / 703-698-6225
EMAIL: tbmalone@carlow.com
RECORD NO.: HSI00157

GENERAL OVERVIEW:
SHIPSHAPE Hypertext Tool for ASTM-F-1166 (HT-1166) evolved from a demonstrated need to quickly locate and extract specific items of information from ASTM-F-1166, entitled "Standard Practice for Human Engineering Design for Maritime Systems, Equipment and Facilities." Te objective of the tool is to assist an analyst in quickly and accurately identifying and accessing required sections or criteria of ASTM-1166. There are six main parts to HT-1166: 1) the Index Screen, 2) the Context Screen, 3) the Text Screen, 4) Figures, 5) Tables, and 6) Notes. The Index Screen contains two methods for accessing the content of ASTM-1166 - an index and a table of contents. The index contains every word in ASTM-1166 in alphabetical order with the number of occurrences of the word next to it. The analyst uses the scroll bar or the UP and Down cursor keys to scroll through the index. As an alternative, the user can click on the "?" box in the middle of the scroll bar to quickly jump to a specific word. When the user finds the word in the index that he/she is interested in, he/she can click on it, and HT-1166 displays every occurrence of that word in context (i.e., with 10 or 15 of the surrounding words). The table of Contents is a duplicate of the Table of Contents contained in ASTM-1166. The Table of Contents is scrollable, and any item can be selected to display the corresponding section of ASTM-1166.

APPROPRIATE USES:
Design documentation, 1166 look-up, and derivation of test and evaluation criteria.

EQUIPMENT REQUIRED:
- Apple(r) Macintosh running System 6.0 or higher
- HyperCard 2.1 or later

INPUTS REQUIRED:
Requirement to access ASTM-1166 criteria.

PROCESSING TECHNIQUES:
Resident in HyperCard.

OUTPUT:
Word processing document containing sections cut-and-pasted from ASTM-1166.

USES OF OUTPUT:
Uses of ASTM-1166 data.

DOCUMENTATION:
SHIPSHAPE Hypertext Tool for ASTM-F-1166 (HT-1166) User's Guide.

ALTERNATIVE/COMPARABLE APPROACHES:

STAGE OF DEVELOPMENT:
Completed.

VALIDATION:
Being validated in the Fast Sealift Ship manning reduction program, SC 21 Ship, Autonomic Ship, Arsenal Ship, Smart Ship, reduced manning bridge, and automated ship auxiliaries.

COMMENTS:

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: Simulation Network Analysis Project (SNAP)

SPONSOR: Air Force Research Laboratory
POINT OF CONTACT: Lt Jesse B Zydallis / 937-255-2706, DSN: 785-2706
EMAIL: jesse.zydallis@flight.wpafb.af.mil
RECORD NO.: HSI00140

GENERAL OVERVIEW:
The Simulation Network Analysis Project (SNAP) was started in 1993 at WL/FIGD, now AFRL/VACD. AFRL/VACD is the Control Integration and Assessment Branch of Air Vehicles (VA). The idea of the project came from the need to quantitatively measure simulation system accuracy and network latency. Simulation latency has been identified as a problem area when high-fidelity simulations are attempted. Training tasks, such as formation flying and aerial refueling, are nearly impossible with some of the latencies found in today's simulation systems. The SNAP project was designed to not only identify delays in simulation systems (such as pilot stick input to visual display output), but also to gather latency data on long-haul networks. SNAP has been involved in several major simulation network exercises, and has proven itself as a credible simulation system and network research tool.

APPROPRIATE USES:
Deterministic evaluation of networked simulation system accuracy and latency.

EQUIPMENT REQUIRED:
SNAP analysis system: Pentium-based mounted PCs; PC GPS interface and antennae; 3Com Etherlink 16 Ethernet interfaces; SCRAMNet PC interface boards; in-house custom-designed EVDAS II; Intel iRMX real-time operating system; National Instruments Lab Windows GUI.

INPUTS REQUIRED:
Data from various test points within a simulation and display video in raster format for input into the Electronic Visual Display Attitude Sensor (EVDAS), which measures a pilot's display variables, such as out-the-window roll and pitch.

PROCESSING TECHNIQUES:
Portable computer system, linked by GPS, which measures simulation network latencies down to 1/10 millisecond.

OUTPUT:
A report on simulation system performance and network latencies.

USES OF OUTPUT:
Quantitative results that can help simulation facilities minimize latency problem areas; establishment of technology baselines for network simulation latencies and accuracies; development of solutions for latency problem areas in simulation systems and networks.

DOCUMENTATION:
A user's manual is available.

ALTERNATIVE/COMPARABLE APPROACHES:
None.

STAGE OF DEVELOPMENT:
Completed; periodically enhanced.

VALIDATION:

- 1994: McDonnell Douglas test, A-10 Networking Study, I/ITSEC test.
- 1995: in-house PIO Studies, Avionics ITB tests, McDonnell Douglas test, I/ITSEC test.
- 1996: DIS vs. DIS-Lite testing, JADS testing, Avionics ITB tests, I/ITSEC test.
- 1997: NETS test, McDonnell Douglas test, TRACE testing, I/ITSEC test.
- 1998: TRACE testing, HLA Phase I test, Phoenix and SNAPpy testing, I/ITSEC test (Nov.).

COMMENTS:
Web site: http://www.va.afrl.af.mil.
Associated AFRL/VACD projects: Joint Modeling Simulation Integration Program (JMSIP); Network Evaluation for Training and Simulation (NETS); Trans-Atlantic Research into Air Combat Engagements (TRACE); DIS vs. DIS-Lite Testing; DIS-Lite SBIR; SNAPpy SBIR.

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: Subjective Workload Assessment Technique (SWAT)

SPONSOR: Air Force Research Laboratory
POINT OF CONTACT: Mr Mike Reynolds / 937-255-4842, DSN: 785-4842
EMAIL: reynolds@cpo.al.wpafb.af.mil
RECORD NO.: HSI00094

GENERAL OVERVIEW:
SWAT provides an easily administered subjective scaling method to be used in the cockpit or other crewstations and work environments to quantify the mental workload associated with various activities. SWAT postulates a multidimensional model of workload comprising three three-point dimensions or factors: 1) time load, 2) mental effort load, and 3) psychological stress load.

APPROPRIATE USES:
SWAT is available to government, industry, and academia, in both domestic and international markets. SWAT was developed in response to the need for a subjective workload measure with known metric properties that is useful in operational or "real-world" environments. SWAT is an easily administered subjective workload tool that can be used in the cockpit or other workstation environments to quantify the workload associated with various tasks or activities. SWAT has been used in diverse environments, for example: high-G centrifuge; command, control, and communications centers; nuclear power plants; domed flight simulators; task simulators; real flight; and laboratory settings.

EQUIPMENT REQUIRED:
SWAT is implemented on an IBM or PC-compatible system with a minimum of 512K internal memory, and two floppy-disk drives or one fixed and one floppy drive. An 8087 math coprocessor will speed up the program, but is not necessary for execution. The program can analyze scale development data for up to 30 subjects.

INPUTS REQUIRED:
No specific inputs are required. The process for conducting a SWAT assessment is described below. The software, user's guide, and other assorted testing materials are available from CSERIAC.

PROCESSING TECHNIQUES:
SWAT involves a two-step procedure: scale development and event scoring. In the first step, subject ranks, from lowest to highest workload, 27 combinations of three levels of the three workload scales. The SWAT program then calculates the score for every combination of ratings on the three subscales. During the event-scoring phase, the subject is asked to provide a rating (1,2,3) for each subscale. The researcher then maps the set of ratings to the SWAT score (1 to 100), which is calculated during the scale development phase. This data is transformed by means of conjoint measurement, into an interval scale of workload. The SWAT score is considered the workload value for that activity.

OUTPUT:
As mentioned above, the SWAT score ranging from 1 to 100 is the primary output of the technique. The minimum value is 0, which represents virtually no perceived workload; the maximum value is 100, which represents high workload.

USES OF OUTPUT:
The SWAT results can be used by researchers, designers, and engineers to evaluate the impact that system or task demands place on an operator's perceptions of mental workload.

DOCUMENTATION:

Reid, G.B., Potter, S.S., & Bressler, J.R. (1987). User's Guide for the Subjective Workload Assessment Technique (SWAT) (AAMRL-TR-87-023), Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory.

Reid, G.B., & Nygren, T.E. (1988). The Subjective Workload Assessment Technique: A Scaling Procedure for Measuring Mental Workload, in P. Hancock & N. Meshkati (Eds.), Human Mental Workload, Amsterdam, the Netherlands: North Holland.

Beare, A.N., & Dorris, R.E. (1984). The Effects of Supervisor Experience and the Presence of a Shift Technical Advisor on the Presence of Two-Man Crews in a Nuclear Power Plant Simulator, in Proceedings of the Human Factors Society 28th Annual Meeting (pp. 242-246), Santa Monica, CA: Human Factors Society.

Courtright, J.F. & Kuperman, G. (1984). Use of SWAT in USAF system T&E, in Proceedings of the Human Factors Society 28th Annual Meeting (pp. 700-703), Santa Monica, CA: Human Factors Society.

Whitaker, L., Peters, L., & Garinther, G. (1989). Tank Crew Performance: Effects of Speech Intelligibility on Target Acquisition and Subjective Workload Assessment, in Proceedings of the Human Factors Society 33rd Annual Meeting (pp. 1411-1413), Santa Monica, CA: Human Factors Society.

ALTERNATIVE/COMPARABLE APPROACHES:
Other subjective workload rating techniques that have demonstrated proven sensitivity to task demand in complex systems, include the NASA Task Load Index (TLX) and Modified Cooper-Harper (MCH) Scale.

STAGE OF DEVELOPMENT:
SWAT is currently available from CSERIAC for a cost-recovery fee. To receive more information about SWAT, please contact CSERIAC.

Mail: AFRL/HEC/CSERIAC
Bldg. 196, Rm. 8
Attn: Products & Services
2261 Monahan Way
Wright-Patterson AFB, OH 45433-7022

Phone: (937) 255-4842 / DSN 785-4842
Fax: (937) 255-4823 / DSN 785-4823

VALIDATION:
SWAT has been used in countless studies in academia, government, and industry. References can best be found in the Psych. Info./Lit. database, as well as DTIC DGIS.

COMMENTS:
None.

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: Systems Operator Loading Evaluation (SOLE)/Integrated Performance Modeling Environment (IPME)

SPONSOR: Defence and Civil Institute of Environmental Medicine
POINT OF CONTACT: Mr Keith Hendy / 416-635-2074, DSN: 827-2074
EMAIL: kch@dciem.dnd.ca
RECORD NO.: HSI00186

GENERAL OVERVIEW:
SOLE/IPME is an integrated tool for performing mission analysis, function analysis, function allocation, task analysis, and workload/performance prediction modeling. SOLE is a collection of commercial and purpose-built software which has evolved over 14 years of use in Canadian Forces procurement projects. SOLE/IPME consists of: a graphic user interface to a relational database (Sybase(r)), for managing the function and task decomposition; a special-purpose shell that interacts with the other components of SOLE/IPME to automatically produce function allocations, Function Flow Diagrams (FFD), Operator Sequence Diagrams (OSD), and post-process various workload measures (attentional demand, task conflict, % time occupied, number of concurrent tasks, W/INDEX, instantaneous time pressure); and the IPME(r) module for building task networks, running the task network simulation, and producing simulated task time-lines. Each phase represents a successive decomposition of the previous one to ensure consistency as one passes from function descriptions to FFDs to OSDs to task networks. The OSD represents the task network model that will be used in workload and performance predictions.

IPME incorporates two models of the human information processor, the UK's DERA-CHS (Farnborough) Prediction of Operator Performance (POP) model, and DCIEM's Information Processing/Perceptual Control Theory (IP/PCT) model. SOLE adds the following capabilities to IPME: a full relational database (Sybase(r)) and database management tools; the ability to handle extensive textual input to task and function descriptions; customized reports; automatic 'first pass' function allocation; automatic FFD and OSD generation; workload calculations based on the VACP attentional demand method, W/INDEX, % time occupied, task conflicts, and number of tasks.

APPROPRIATE USES:
Front-end human engineering analysis in accordance with MIL-HDBK-46855, including mission analysis, function analysis, function allocation, task analysis, and workload/performance prediction modeling.

EQUIPMENT REQUIRED:
UNIX SGI IRIX 6.2 or higher, RedHat Linux 4.2 or higher; SGI Indigo for Linux, any x86 platform (Pentium class preferred); minimum 16 MB RAM (32 MB preferred); 25 MB hard drive; OS-dependent video card.

SOLE/IPME and IPME differ in their interface with the user and the power of database support. SOLE/IPME requires that the SYBASE relational database be resident on the host computer, and that the user create Function Flow Diagrams, Operational Sequence Diagrams and Task Networks within SOLE/IPME through a remote SYBASE graphical user interface (GUI) resident on an IBM-compatible computer running NT 4.0. Hence, the SOLE environment consists of two hardware elements: an NT-based PC housing the SOLE GUI; and an SGI Workstation housing the database server and IPME facility. The following list corresponds to the requirements to establish a complete system at the

host facility. Work is underway that will enable access to the server remotely from a PC environment.

PC running NT; Impact or Indigo class SGI running IRIX 6.2
Pentium 166 or better; R4400 SGI or better
32 MB RAM for PC; 32 MB for SGI (64 MB preferred)
PC requires approximately 700 KB storage space; SGI requires 500 MB (databases included)
RAGE Pro ATI or equivalent video card for PC; standard Impact or Indigo graphics for SGI
PC IDEO from B2 Systems, Sybase ODBC drivers, SOLE custom s/w for PC; SQL Sybase, IPME from Micro Analysis & Design, SOLE custom s/w for SGI

INPUTS REQUIRED:
A detailed function and yask analysis, with task completion times, time criticality or priority of tasks, sequence of tasks if appropriate, nature of tasks (sensory domain, discrete, continuous, repeating, etc.); the presence and properties of various stressors and other task performance modifiers (time pressure, environmental factors, training, aptitude, etc.). Within SOLE/IPME extensive use of default values is made to ease data entry. If the Prediction of Operator Performance workload model is used, then task demand estimates are required for Input, Cognitive, and Output domains, as well as an optional Time Pressure category.

Standard task analysis methods (including hierarchical and cognitive task analysis).

Observation, subject matter interview, video/audio recording, examination of existing similar systems.

Various standard instruments for interviews and field data gathering.

PROCESSING TECHNIQUES:
No particular preprocessing is required. The only requirement to be met prior to the utilization of the SOLE/IPME facility is the analysis of the mission to be performed and the assumptions established to define the system to be analyzed.

SOLE/IPME provides relational database management (including visual representations of the database in the form of FFDs and OSDs), and network modeling capabilities for workload and performance prediction. A Function allocation module, based on rules from a modified Fitts list, makes a first pass at assigning functions between human and machine. These assignments can later be changed by the analyst. The relational database allows tasks that are called up at various times during the scenario, to be described once only. Through parent-child relationships one parent task can spawn many children. A change in the parent task description affects all children of that task, while local changes to the child do not propagate to the parent or to the other children.

Various human information models are built into the software for making workload calculations based on attentional demand, task conflict, W/INDEX, % time occupied, number of concurrent tasks, POP, and the IP/PCT model. The IP/PCT model includes an allocation of attention module that dynamically determines the task time-line at run time. The concept of task priority that drives the allocation of attention module is based on the value of time pressure for that task (time required: time available). As tasks are delayed or interrupted, the value of time pressure will increase for a given task, as the time to process approaches the latest allowable completion time for

that task. Tasks are serviced in order of priority. Priority categories (1-9) set the latest completion time based on the allowable slippage in time (e.g., no slippage, 25%, 50%). Workload calculations are based on the average peak time pressure over all active tasks. This is calculated over a moving time-line window, as set by the analyst. The IP/PCT model includes both single-channel and multi-tasking behaviors. Interference in multi-task situations is based on structural interference (you can't look in two directions at once) and on time-multiplexed serial processing in higher-level cognitive structures.

OUTPUT:
SOLE/IPME supports most of the required front-end HFE analysis effort, during the concept development and feasibility stages of design, as prescribed in MIL-HDBK-46855. It supports an iterative process that should finally result in a proposed function allocation and task inventory that have been 'validated' through workload and performance prediction. 'Validated', in this sense, means that the workload and/or performance prediction suggests that the conceptual design will meet the performance requirements within the capabilities of the operators. Generally, the underlying model for predicting operator workload or performance has had minimal validation, particularly as a predictor of overall system performance. All reports generated are compatible with standard word processing programs, and tabular data can be imported into common spreadsheet application.

The output generated by the SOLE application consists of several individual reports, generated at differing levels of the analysis. As such, the analyst need not exercise the full functionality of the system before data may be released for review. The Function Analysis produces a tabular mission decomposition and graphical FFDs. The Task Analysis results in a series of tabular reports, including Function Allocation report, Task Analysis forms, Critical Task Analysis report, Information Flow, and Processing reports. The development of task network models as a conclusion to the Task Analysis results in the generation of OSDs in a graphical format.

The reports generated fall into two categories. Tabular data is stored in ASCII files, and may be imported directly into any word processor or spreadsheet. Graphical data is stored in PostScript(r) format, which may be imported by most standard word processors.

The Information Flow and Processing Analysis (as part of the Task Analysis) consists of a series of tabular reports identifying such information elements as Action Requirement, Information Requirements, Initiating Conditions, Feedback, Skill Requirements, Decisional Element, Knowledge Base Requirements, Task Criticality, and Ability Requirements associated with the task inventory.

USES OF OUTPUT:
The 'validated' task analysis drives the interface and workspace design. From the task time-line, one can determine the numbers of controls and displays needed for the design, and establish timing information that sets the required completion times for various activities and sequence of activities.

The use of the output is defined by the depth of the analysis. Upon completion of the Task Analysis, an extensive set of documentation has been established defining the nature of the requirements associated with the successful completion of the task set. This may be used directly in the development of Interface Requirements specifications.

The Performance Prediction Analysis generates sufficient data/information to assess the 'validity' of the subject task network models. An analysis of these results will generate recommendations regarding the necessity for task redesign or reallocation.

Analyst qualifications: HFE experience with 10 days training on the software (approximately 5 days each on SOLE and IPME modules).

DOCUMENTATION:
Dahn, D.A., Laughery, K.R., and Belyavin, A.J., "The Integrated Performance Modeling Environment: A Tool for Simulating Human-System Performance", Proceedings of the 41st Human Factors and Ergonomics Society Conference, Albuquerque, NM, Oct., 1997.

Dahn, D.A., and Laughery, K.R., "The Integrated Performance Modeling Environment: Simulating Human System Performance", Proceedings of the 1997 Winter Simulation Conference, Atlanta, GA, Dec., 1997, p. 1141-1145.

MAAD (1997), Integrated Performance Modelling Environment - Version 1.4, Boulder, CO, USA: Micro Analysis and Design.

SOLE is described in:

CMC (1994), "System Operator Loading Evaluation: Methodology Documentation (SSC Contract W7711-2-7160/01/XSE for DND, Ottawa, Can.), Kanata, Ontario, Canada: Canadian Marconi Company.

ALTERNATIVE/COMPARABLE APPROACHES:
Wincrew, SWAS, W/INDEX, MIDAS, HFTD

STAGE OF DEVELOPMENT:
SOLE, Version 3.0; planned upgrades include making SOLE usable on the Internet; available from POC.

VALIDATION:
Cain, B. (1997), "An Evaluation of Workload Model Predictions in a Helicopter Environment (DCIEM 97-R-66)", North York, Ontario, Canada: Defence and Civil Institute of Environmental Medicine.

East, K.P., Hendy, K.C., and Matthews, M. (1996), "Validation of an Information Processing-Based Model for Workload and Performance Prediction", in Proceedings of the Human Factors Society of Canada, 29th Annual Conference, Mississauga, Ontario, Canada: Human Factors Association of Canada, 155-160.

Hendy, K.C., Liao, J., and Milgram, P. (1997), "Combining Time and Intensity Effects in Assessing Operator Information Processing Load", Human Factors, 39(1), 30-47.

The first reference compares workload predictions obtained by McCracken and Aldrich's VACP method with rated workload using the NASA TLX. The next two studies investigate the predictive validity of the IP model, currently resident in SOLE, in a simulated Air Traffic Control environment. A major activity is underway within the Defense Departments of the TTCP countries (Australia, Canada, New Zealand, United Kingdom, and the United States) to competitively validate the primary task-based workload/performance tools in use by member countries.

COMMENTS:
Points of Contact:

Mr. David A. Dahn
Micro Analysis and Design, Inc.
4900 Pearl East Cir., Ste. 201 E
Boulder, CO 80301
(303) 442-6947 / FAX (303) 442-8274
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415 Legget Dr.
Kanata, Ontario K2K 2B2, Can.
(613) 592-7400 / FAX (613) 592-7432
gyoungson@kan.marconi.ca

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: Task Analysis Workload (TAWL)

SPONSOR: Army Research Institute
POINT OF CONTACT: Mr Dennis Wightman / 334-255-2834, DSN: 558-2834
EMAIL: wightman@rwaru-emh1.army.mil
RECORD NO.: HSI00047

GENERAL OVERVIEW:
TAWL uses task analysis information to develop operator workload prediction models, i.e., estimates of the workload associated with the cognitive, psychomotor, and sensory components of individual and concurrent operator tasks. TAWL can be used with a variety of databases, such as the TAWL Operation Simulation System (TOSS). (TOSS is a database for aircraft which includes the UH60, AH64, CH47, MH47, and MH60.)

APPROPRIATE USES:
With the TOSS database, TAWL can be used to determine the optimal system design or configuration for a mission based on workload considerations, develop models of two or more systems to identify the systems or configurations with higher workload, and evaluate a system's manning and training requirements.

EQUIPMENT REQUIRED:
The equipment required to use TAWL consists of an IBM-compatible computer and keyboard with 640K of memory on a DOS operating system version 2.0 or greater. A hard disk drive and a printer are recommended.

INPUTS REQUIRED:
The inputs required to use TAWL include: (1) task analysis data (mission phases, segments, functions, and tasks; person(s) performing each task; subsystem(s) associated with each task; and estimates of the duration of each task); (2) task workload ratings; (3) function and segment decision rules; and (4) overload thresholds.

PROCESSING TECHNIQUES:
Processing capabilities include model execution and simulation (with optional randomization of tasks and functions), computation of workload metrics, and file handling of all model input and output.

OUTPUT:
The TAWL output consists of workload metrics (number of overload conditions, number of component overloads, and overload density) for segments and crewmembers, summary of subsystem overloads, and task listings. Analyses can be made for up to four crewmembers.

USES OF OUTPUT:
The output from TAWL can be used to identify mission time periods, components, crewmembers, and subsystems with high workload. This information can be used in the system design process, e.g., to make adjustments in the distribution of tasks during the mission to equalize workload over time and over crewmembers, or to make adjustments in the nature of tasks.

DOCUMENTATION:
Bierbaum, C.R., Fulford, L.A., and Hamilton, D.B., "Task Analysis/Workload (TAWL) User's Guide (Draft Research Product for ARI)," Ft. Rucker, AL:

Anacapa Sciences, Inc., 10-89.

Iavecchia, H.P., Linton, P.M., Bittner, A.C. Jr, and Byers, J.C., "Operator Workload in the UH-60A Black Hawk: Crew Results VS. TAWL Model Predictions," Proceedings of the Human Factors Society, 33rd Annual Meeting, Santa Monica, CA: Human Factors Society, 1989.

ALTERNATIVE/COMPARABLE APPROACHES:
Computer-Aided Function Allocation Evaluation System (CAFES): Workload Assessment Model (WAM). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratories, Human Engineering Procedures Guide (AFAMRL-TR-81-35).

STAGE OF DEVELOPMENT:
Completed. To obtain, contact: Mr. Charles Gainer, Army Research Institute, Aviation R&D Activity, (PERI-IR), Ft. Rucker, AL 36362-5354.

COMMENTS:
TOSS is menu-driven. It provides workload estimates for up to six workload components.

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: Training Analysis Support Computer System (TASCS)

SPONSOR: Headquarters Air Education & Training Command
POINT OF CONTACT: Mr Robert L Denton / 210-652-3194, DSN: 487-3194
EMAIL: dentonr@rndgatel.aetc.af.mil
RECORD NO.: HSI00160

GENERAL OVERVIEW:
TASCS is an instructional design tool. It uses a database-oriented approach. The software is written in CLIPPER, a compiler that provides a superset of dBase language. TASCS is used to build databases of tasks, training objectives, media, and units/lessons. This process is reflected in the main menu, which provides choices of task, objective, media, and syllabus analysis.

APPROPRIATE USES:
The default data contained in this tool was clearly developed for the Air Force. Although certain default data are modifiable, many factors are fixed. The number and type of characteristics cannot be changed. The tool is most useful for people who use the instructional design model underlying the program. The usefulness for others is limited. The characteristics are designed for Air Force operations. Air Force trainers may find the tool particularly useful.

EQUIPMENT REQUIRED:
IBM-compatible computer with MS-DOS 3.0 or higher, 640 Kb RAM, 10Mb hard disc space, and a printer.

INPUTS REQUIRED:

PROCESSING TECHNIQUES:

OUTPUT:
TASCS generates various tasks, objectives, and syllabus reports to aid the instructional design process. The final product, the syllabus report, lists such items as objectives, time to train, media, instructional methods and strategies, evaluation methods, and proficiency levels.

USES OF OUTPUT:

DOCUMENTATION:
None.

ALTERNATIVE/COMPARABLE APPROACHES:
None known.

STAGE OF DEVELOPMENT:
Current version was developed in April, 1991. No further updates are available or contemplated.

COMMENTS:

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: Transom(tm) Jack(r) Human Simulation Software

SPONSOR: Transom Technologies, Inc
POINT OF CONTACT: Sales Dept / 734-761-6001
EMAIL: info@transom.com
RECORD NO.: HSI00184

GENERAL OVERVIEW:
Transom Jack is a human-centric visual simulation software package that enables users to create virtual environments by modeling them natively or importing CAD data, populate their environment with biomechanically accurate human figures, assign tasks to these virtual humans, and obtain valuable information about their behavior. Transom Jack provides the industry's highest-fidelity human model, with accurate joint limits, a fully defined spine, flexible anthropometric scaling, and such advanced behaviors as head/eye tracking, natural walking, balance control, seeing, reaching, grasping, bending, and lifting.

APPROPRIATE USES:
Organizations use Transom Jack to improve the ergonomics and human factors of product designs, manufacturing processes, and maintenance procedures.

By using simulation to evaluate the needs of humans in the earliest phases of product design, organizations ensure that products are safer, more useful, and more comfortable for the targeted user population. Just as importantly, Transom's software enables users to solve human-related design issues earlier, get closer to their final design faster, and thereby minimize the number of physical prototypes they have to test. This translates into accelerated time to market and lower development costs.

Organizations are realizing similar benefits from Transom software solutions in manufacturing and maintenance. By factoring in the needs of humans early in the design of manufacturing and maintenance tasks, organizations are bringing factories online faster, optimizing productivity, improving worker safety, and minimizing the time and cost required to maintain products.

EQUIPMENT REQUIRED:
Transom Jack is a stand-alone software package that runs on any of three platforms -- Silicon Graphics workstations (IRIX), Hewlett-Packard workstations (HP-UX), and Intel PCs (Windows NT):

- IRIX 6.X - R4400 (R10000); 32 MB RAM (64-128 MB recommended); 130 MB hard drive; any video card; SGI OpenGL Optimizer (free)
- HP-UX 10+ - HP PA 7300 and above; 32 MB RAM (64-128 MB recommended); 130 MB hard drive; OpenGL-compliant video card; SGI OpenGL Optimizer (free)
- Windows NT - Pentium II; 32 MB RAM (64-128 MB recommended); 130 MB hard drive; OpenGL-compliant video card; SGI OpenGL Optimizer (free)

INPUTS REQUIRED:
Create 3D objects within Transom Jack, or import 3D data based on all popular formats (IGES, VRML, STL, DXF, etc.), translated into Transom Jack.

PROCESSING TECHNIQUES:
Transom Jack provides a data reduction functionality to reduce the size of

large 3D databases to enable fast frame-rate (real-time) simulation.

Transom Jack is a real-time visual simulation system based on fast inverse kinematics. The human "manikins" created by the software are based on an anthropometry database derived from the ANSUR 88 U.S. Army Natick Lab 1988 survey of American service men and women. Transom Jack digital people have 74 segments, including a realistic 22-segment spine and 16-segment hands, and they obey joint and strength limits derived from NASA studies.

The procedure for using Transom Jack is as follows:
- Import CAD models or build virtual environments from scratch.
- Insert biomechanically correct virtual humans and size using reliable anthropometric data.
- Transom Jack can see, walk,balance, reach, grasp, bend, and lift -- in real time.
- Simply assign complex tasks, change people and objects parametrically, then rerun the same simulation.
- Use Transom Jack to capture and mimic actual motion of live subjects.
- Evaluate how Transom Jack performs through real-time simulations and ergonomic analyses.

OUTPUT:
- 3D images and simulations (in popular image and movie formats)
- Low back spinal force analysis reports
- NIOSH lifting studies
- Metabolic energy expenditure reports
- Comfort assessments
- Static strength predictions
- Reach envelopes
- Safety zones
- Seating accomodation reports
- Visibility information
- Multi-person interaction studies

USES OF OUTPUT:
Output from Transom Jack is used in various applications related to human-centered design, human-intensive virtual manufacturing, maintenance task planning, and simulation-based training:

Human-centered design applications
- Fit and comfort
- Ingress and egress
- Visibility
- Strength requirements
- Multi-person activity
- Reach, grasp, and manipulation
- Foot pedal operation

Manufacturing task planning applications
- Workcell layout
- Workflow simulation
- Manual assembly
- Material handling
- Assistive device usage

Maintenance task planning applications
- Accessibility and space claims
- Part removal and replacement
- Manual task studies
- Visibility
- Strength capability

- Injury risk assessment

Simulation-based training applications
- Training videos
- Multimedia presentations
- VR training programs

Analyst qualifications: Bachelor's degree and/or 3D software user experience helpful; two-day training course required.

DOCUMENTATION:
Transom Jack User's Guide, Transom Jack User's Guide Addendum, Introductory Training Tutorial, Advanced Training Tutotial

ALTERNATIVE/COMPARABLE APPROACHES:
N/A

STAGE OF DEVELOPMENT:
Transom Jack is in its second commercial release, known as Transom Jack 1.2. The next version, Transom Jack 2.0, will be available in June, 1998.

VALIDATION:
"Efforts in Preparation of Jack Validation", Francisco Azuola, et al., published in Dec., 1997, by the Army Research Laboratory at Aberdeen Proving Ground, MD, Report #ARL-CR-418. To obtain copies, contact the Defense Technical Information Center (DTIC).

COMMENTS:
Transom teaches introductory and advanced training courses for Transom Jack at its Ann Arbor facility. Update courses are also available for new versions of the software.

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: USARIEM Heat Strain Model, P2NBC2 Heat Strain Decision Aid Implementation, Version 2.1

SPONSOR: Army Medical Research and Materiel Command, USARIEM
POINT OF CONTACT: Mr William T Matthew / 508-651-5140, DSN: 256-5140
EMAIL: matthew@natick-ilcn.army.mil
RECORD NO.: HSI00104

GENERAL OVERVIEW:
The USARIEM Heat Strain Model, as currently implemented in the P2NBC2 Heat Strain Decision Aid (HSDA), is a menu-driven tool designed to help predict and enhance soldier performance and endurance. Predicted values are based on user-specified environmental conditions, work level, acclimatization status, and clothing types. Results can be viewed in numeric or graphic displays, and can be saved and exported to other applications.

APPROPRIATE USES:
1. Evaluation of weather effects on individual drinking water needs, work/rest limits, and maximum work times.
2. Heat casualty risk assessment.

EQUIPMENT REQUIRED:
Minimum: IBM-compatible computer, 386 or better with 470 kilobytes of available random access memory (RAM). A hard drive with 1 megabyte of storage space, 3.5" high-density floppy drive, and VGA color monitor.

INPUTS REQUIRED:
Air temperature, humidity, wind speed, solar load category, soldier characteristics (height, weight, acclimatization status), clothing type, and physical work/activity level required to accomplish the specified military task.

PROCESSING TECHNIQUES:
Processing employs algorithms which evaluate heat exchange between the soldier and environment, and estimate a final equilibrium body core temperature. Time series estimates for safe work time and work/rest cycles are based on interpolation methods and iterative solutions. Heat casualty risk estimates are based on a cumulative probability density function for casualty expectation vs. equilibrium body core temperature.

OUTPUT:
Outputs include: optimal work/rest cycle limits, maximum safe work time, hourly drinking water needs, equilibrium core temperature, and probability of casualty. Graphic display of multiple condition and time series data are available. Data may be saved as standard ASCII files.

USES OF OUTPUT:
1. Evaluation of the effects of various clothing types on military task performance.
2. Evaluation of weather effects on task performance and heat injury risk.
3. Evaluation of the effects of soldier attributes and acclimatization.

DOCUMENTATION:
1. P2NBC2 Heat Strain Decision Aid User's Guide, Version 2.1, Science Applications International Corporation, April 1993, DTIC No. AD-A2660672.

Pandolf, K.B., Stroschein, L.A., Gonzalez, R.R. and Sawka, M. N. "Prediction Modeling of Physiological Responses and Human Performance in the Heat", Computers in Biology and Medicine, 16:310-327, 1986.

ALTERNATIVE/COMPARABLE APPROACHES:
The Integrated Unit Simulation System (IUSS) contains a module for stress effects in small-unit operational scenarios.

STAGE OF DEVELOPMENT:
Version 2.1 is developmental. When funding becomes available, adjustments to reduce over-prediction of thermal strain under some circumstances will be implemented.
Version 2.1 P2NBC2 Heat Strain Decision Aid may be obtained from:

SAIC
ATTN: C. Dunn
626 Town Center Dr., Ste. 205
Joppa, MD 21085
Tel. 410-679-9800

VALIDATION:
1. Moran, D. Y., Shapiro, Y., Epstein, R., Burstein, L., Stroschein and K. Pandolf, "Validation and Adjustment of the Mathematical Prediction Model for Human Rectal Temperature Responses to Outdoor Environmental Conditions", Ergonomics, 38:1011-1018, 1995.

COMMENTS:
Source Code for the USARIEM Heat Strain Model/P2NBC2 HSDA is written in the Ada programming language.

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: VISION 3000 Software

SPONSOR: VISION OCCUPATIONAL HEALTH SYSTEMS, US Subsidiary of Promatek Industries
POINT OF CONTACT: Ms Adrienne Krakar-Waller / 800-999-1899 x2
RECORD NO.: HSI00108

GENERAL OVERVIEW:
Vision 3000 Software is the next generation in ergonomic and biomechanical job task analysis. Modules consist of NIOSH Multi-Task Lift Analysis, WATBAK Asymmetrical Lift Analysis, 2D Strength Analysis, Posture/Range-of-Motion, and Dimensional Profile.

APPROPRIATE USES:
Uses include, but are not limited to, ergonomic evaluation, consulting, job site analysis, post-offer screenings, and job redesign for compliance with safety issues.

EQUIPMENT REQUIRED:
IBM-compatible 486 or above; 4 MB RAM; HP Deskjet 1200C or laserjet printer; SONY 8MM camcorder and player.

INPUTS REQUIRED:
Software interfaces with the University of Michigan's 2D Static Strength Prediction Program and the University of Waterloo's (Ontario, Canada) WATBAK program.

PROCESSING TECHNIQUES:
Four-step process starts by videotaping subject, capturing the frames, analyzing and reporting.

OUTPUT:
Analyses consisting of biomechanical data.

USES OF OUTPUT:
Reports can be used in determining courses of actions to be taken in regards to job redesign, training and compliance issues.

DOCUMENTATION:
Manual with step-by-step directions.

ALTERNATIVE/COMPARABLE APPROACHES:
VISION 3000 is a unique product. No one else manufactures the same analyses/modules.

STAGE OF DEVELOPMENT:
VISION 3000 is now complete. The system has grown in the past five years from one module to its current five. Updates will continue as technology changes.

VALIDATION:
NIOSH has conducted independent testing, and currently uses the software.

COMMENTS:
VISION 3000 is a stand-alone program, and is copyright-protected.

OVERALL CATEGORY: Tool
STATUS: Available

TITLE: WinCrew

SPONSOR: Micro Analysis and Design, Inc
POINT OF CONTACT: Ms Catherine Barnes / 303-442-6947
EMAIL: cbarnes@maad.com
RECORD NO.: HSI00161

GENERAL OVERVIEW:
WinCrew is a task and workload analysis tool. It predicts system performance as a function of human performance. It models behaviors in response to workload levels which may affect performance.

APPROPRIATE USES:
Predict and assess changes in system performance as a result of varying function allocation, number of operators or crew, level of automation, task design, mode of information presentation, and response to high workload.

EQUIPMENT REQUIRED:
Win 3.1x, Win 95, or Win NT; 486 CPU minimum, Pentium preferred; 16 MB of RAM minimum; 16 MB hard drive; SVGA video card.

INPUTS REQUIRED:
Functions, function sequences, task times and sequences, initial operator assignment to tasks, consequences of error, automation concept (function allocation), crewstation design concept (as it affects mental resources used to perform tasks), and workload associated with tasks.

Task times and some sequencing information come from field data, estimates from algorithms/lab studies (some available as 'micromodels' in the software, and estimates from subject matter experts. Operator task assignment, task sequencing, automation concept (function allocation), crewstation design concept (as it affects mental resources used to perform tasks), and workload associated with tasks are all derived from the system designers' concept of how the system will be used and how the human operators will perform necessary tasks.

Standard task analysis data collection forms, questionnaires, etc., are used.

PROCESSING TECHNIQUES:
Stochastic network modeling is used to aggregate individual estimates made at the task level up to the system level. After all data input is complete, the user selects a random number seed and executes the model in either 'silent' or 'animation' mode. Animation mode highlights the tasks as they are being executed in the simulation. The tool facilitates sensitivity analysis to determine high drivers for system performance.

OUTPUT:
The following preformatted reports are produced by WinCrew as a result of model execution:

- Mission Summary
- Critical Path Summary
- Task Summary
- Operator Activity
- Operator Workload
- Overload
- Channel Conflict

- Task Timeline
- Crewstation Workload
- Read User Snapshot

In addition, a graph of workload vs. time for the mission for all operators may be generated in MS Excel. A facility of doing this is linked to the Operator Workload report.

USES OF OUTPUT:
Predict and assess changes in system performance as a result of varying function allocation, number of operators or crew, level of automation, task design, mode of information presentation, and response to high workload. Through iterative use, determine high drivers affecting human and system performance. WinCrew has been used to investigate options for reduced manning, effects of different levels of automation, and workload imposed on human operators by system design concepts.

Analyst qualifications: A backgroind in operations research analysis is helpful. Tool users must understand basic task analysis methods and workload concepts. A Bachelor's degree in an HFE-related field is usually sufficient. The training course offered by Micro Analysis and Design (see WinCrew Website) is highly recommended.

DOCUMENTATION:
A WinCrew users manual is available through the WinCrew Website.

Lockett, J., 'Modeling Workload Coping Strategies Using Task Network Modeling', published in the Proceedings of the HCI International '97 Conference, San Francisco, CA, 1997.

Archer, R. and Lockett, J., 'WinCrew - A Tool for Analyzing Performance, Mental Workload, and Function Allocation Among Operators', published in the Proceedings of the ALLFN '97: 'Revisiting the Allocation of Functions Issue', VOL II, pp. 157-165, Galway, Ireland, 1997.

A WinCrew users manual is available through the WinCrew Website.

ALTERNATIVE/COMPARABLE APPROACHES:
IMPRINT or IPME.

STAGE OF DEVELOPMENT:
WinCrew Version 3.2.7 is in distribution, and is being used by various Government agencies and the private sector. Information on WinCrew availability, new releases, etc., is included at the WinCrew Website: http://www.maad.com/WinCrewSupport/index.html.

COMMENTS:
WinCrew is the updated Windows version of the CREWCUT (UNIX-based) workload analysis tool. CREWCUT is no longer available and has been superceded by WinCrew.

OVERALL CATEGORY: Analytic Technique
STATUS: Available

TITLE: 3-D System Safety Engineering Analysis

SPONSOR: Amencie Consultants
POINT OF CONTACT: Dr Mark M Brauer / 512-387-0748
RECORD NO.: HSI00131

GENERAL OVERVIEW:
Industrial Engineering and Safety textbooks follow the seminal DoD specifications and standards on this topic, forcing us to teach System Safety Engineering (SSE) with Severity and Likelihood metrics alone. The 3-D System Safety Engineering Analysis uses a human system analog/model/construct that integrates the human component into the equation by giving human Exposure its due metric status, along with Severity and Likelihood, in describing System Safety, or the lack thereof, throughout our engineering texts, curricula and campuses, and in our US Government specifications and standards. This model should be a key design element used during the conceptual phase of any program, and may be implemented on a PC for definition/comparison of real-world Human Factors/System Safety Engineering problems. This three-dimensional model can be demonstrated in any engineering classroom, design office or developmental laboratory.

The 3-D System Safety Engineering Analysis has the following attributes:
1) Improved 2-D common baseline for Severity and Likelihood metrication/comparison. (Each may still be accessed/used independently of one another and/or the new metric, below.)
2) Added (new) common baseline installed/compatible metric for human Exposure. (Like Severity and Likelihood, above, this metric is also totally autonomous in its implementation, and may be accessed/used independently or in comparison with Severity or Likelihood alone.)
3) Added (new) 3-D worst-case model with which to understand this new technique, and facilitate making comparisons with real-world systems.
4) Improved, visual/physical simultaneous evaluation of a specific design's resulting unique risk character in comparison with either another competing system and/or the worst-case model (above).

APPROPRIATE USES:
1) Specific system's risk determination with improved/expanded cubic/graphic 100-point scale detail.
2) Cubic/graphic comparison of multiple competing systems' risks.
3) Improved ability to build comparative risk database (historical National file).
4) Functional, real-world 3-D math-modeling teaching tool.

EQUIPMENT REQUIRED:
1) May be a paper-&-pencil solution (not requiring any new/specialized equipment).
2) Easily implemented on Mac or PC for a computerized or graphic solution. or graphical solution. the Net.
3) Transportable via Net.

INPUTS REQUIRED:
1) Individual severity and Likelihood metrics still autonomous/still obtained.
2) Once Severity and Likelihood metrics are obtained, new process enables immediate 2-D (planar) graphic comparison/solution.
3) New Exposure metric is obtained using same process that developed both

Severity and Likelihood metrics (entered as a 3rd channel).
  4) Once Exposure metric is obtained, new process enables expanded immediate 3-D (cubic) graphic or solid comparison/solution.

PROCESSING TECHNIQUES:
  1) Spreadsheet matrix and/or pencil-&-paper longhand, planar approach still usable (this process supports and simplifies existing methodologies).
  2) Computer Modeling of any real-world system --
    a) Any two of the three metrics (Severity, Likelihood, and now Exposure) of a given system may now be viewed/manipulated in 2-D with the new, simplified common-vertex planar graphical plot.
    b) All three of the metrics (above) of a given system may now be viewed/manipulated in 3-D with the new, simplified common-vertex cubic plot.

OUTPUT:
  1) All three system-specific metrics are available unambiguously and individually.
  2) A combined system-specific resultant is also available.

USES OF OUTPUT:
  1) To satisfy the need for up-front system's risk analysis and preliminary hazards analysis -- with respect to a given system -- with greater objectivity, precision, and accuracy.
  2) To satisfy the need for a System Safety Engineering tool/model that can be used to standardize and thus improve the repeatability/acceptance of scores allocated to off-the-shelf or developmental systems.
  3) To satisfy the need for objectively selecting the least risky system from a group of real-world alternatives.
  4) To satisfy the need for a standard, worst-case model for comparison (as above), one that can also be used as an SSE teaching tool.

DOCUMENTATION:
MIL-STD-882 and MIL-STD-1574

ALTERNATIVE/COMPARABLE APPROACHES:
None. This new technique expands upon prior art, and provides a new, common vertex that further allows the two original metrics, combined with the third (new) metric, to generate a new visual/solid cubic construct.

STAGE OF DEVELOPMENT:
Released copyrighted/patented (pending) system. To obtain the analytic technique, contact the POC.

COMMENTS:
In process of seeking revision to both referenced MIL-STDs. Machine (computer)-compatible for both solution and storage.

OVERALL CATEGORY: Analytic Technique
STATUS: Available

TITLE: Army Early Comparability Analysis (ECA)

SPONSOR: TRADOC Analysis Center
POINT OF CONTACT: Dr Gordon Goodwin / 804-765-1822, DSN: 539-1822
EMAIL: goodwing@trac.army.mil
RECORD NO.: HSI00001

GENERAL OVERVIEW:
Early Comparability Analysis provides systematic, standardized procedures for evaluating soldier tasks. During the conduct of an ECA, currently fielded equipment is selected to serve as an analytical 'stand-in' for the new or proposed weapon system (usually the stand-in equipment is the predecessor to the new system). Soldiers who work with the selected equipment are queried, using standardized questions to identify problem tasks performed (i.e., high-driver tasks). The standardized questions concern task learning difficulty, learning decay rate, task frequency, percentage of time performing task, and time to train task. The high-driver tasks are identified for the purpose of assuring that similar problem tasks do not recur on the new system.

APPROPRIATE USES:
ECA is designed to be used by the Combat and Training Developers before, during, and after the draft of the Operational and Organizational Plan (O&O Plan). ECAs can be done on major system new starts, non-major new starts, design and materiel change, and Non-Developmental Items.

EQUIPMENT REQUIRED:
The minimal equipment required for an ECA is paper, pencil, and calculator. A microcomputer and spreadsheet software are optional.

INPUTS REQUIRED:
Data sources for an ECA may include Subject Matter Experts (SME), Army Occupational Surveys, Service school surveys, Program of Instruction, Enlisted Master File, O&O Plan, technical manuals, soldiers' manuals, sample data collection, Logistic Support Analysis Records, lesson plans, ARI studies, and task lists.

PROCESSING TECHNIQUES:
The ECA is a twelve-step process that includes the development of a task list, the development of SME questionnaires, collection and tabulation of data, interpretation of results, listing of high-driver tasks, and development of recommended solutions.

OUTPUT:
The Early Comparability Analysis output consists of the identification of high-driver tasks with recommendations for how to assure that these tasks do not recur on the new or emerging systems. Discussions of findings also are provided.

USES OF OUTPUT:
The output from the ECA should be used as feeder data for the Target Audience Description and as lessons learned for the O&O Plan and the Operational Requirements Document. If an MPT solution to a high-driver cannot be found, ECA can be used as input to the Request for Proposal (RFP) to ensure TRADOC's MPT requirements are passed to the materiel developer. ECA output can be used to preclude a repeat of old mistakes.

It also can identify the tasks that need to be closely evaluated during developmental and operational testing.

DOCUMENTATION:
"The ECA Procedural Guide," February, 1987; "Risk and Uncertainty in ECA," 1992.

ALTERNATIVE/COMPARABLE APPROACHES:
None known.

STAGE OF DEVELOPMENT:
The ECA is fully mature. To order 'ECA Procedural Guide', use AD A181260.

Contact: Defense Technical Information Center, Reference and Retrieval Division, ATTN: DTIC-BR, 8725 John J. Kingman Rd., Ste. 0944, Ft. Belvoir, VA 22060-6218; 'phone (703) 767-8274 / DSN 427-8274.

For more information about ECA, contact: TRADOC Analysis Center, ATTN: ATRC-LP (Dr. Goodwin), Ft. Lee, VA 23801-6140.

COMMENTS:
ECA, a lesson-learned analysis, is always performed on existing Army components. The data source components must be an Army system with fielded data. ECA can be done by TRADOC proponents and combat and training developers using existing in-house resources. An average ECA can be completed in a few months. The ECA handbook provides a resource (time) mode to estimate hours required to complete a specific analysis. ECA does not require highly trained analysts.

OVERALL CATEGORY: Analytic Technique
STATUS: Available

TITLE: Army Military-Civilian Cost System (AMCOS)

SPONSOR: Army Cost and Economic Analysis Center
POINT OF CONTACT: Mr George Michael / 703-681-3335
RECORD NO.: HSI00006

GENERAL OVERVIEW:
The Army Military-Civilian Cost System (AMCOS) is a database of active, reserve, and civilian manpower data developed for accuracy and flexibility of manpower cost estimation. It provides military and civilian cost estimates for acquisition, installation operations, force/unit costing, and a variety of cost analysis requirements. AMCOS is used to forecast the life cycle of a new or proposed weapon system by year, for each Military Occupational Specialty (MOS), as well as for the entire system. The models incorporate data from a variety of sources and compute cost elements, such as military compensation, recruiting, training, and medical support for each MOS. These cost elements are then incorporated into a life-cycle cost-estimating routine. The model generates the manpower costs for the life cycle of the system.

APPROPRIATE USES:
This method is appropriate for costing manpower requirements during system development.

EQUIPMENT REQUIRED:
The equipment required to use this method is an IBM-compatible PC.

INPUTS REQUIRED:
The input for this method consists of manpower by grade by MOS.

PROCESSING TECHNIQUES:
The processing of the information specifies manpower requirements by pay grade for each MOS for up to a 30-year life cycle. MOS-specific and total costs are generated.

OUTPUT:
The output is manpower costs by MOS by year and budget appropriation category.

USES OF OUTPUT:
The output is used to develop the most cost-efficient system and develop the cost-effective manpower and hardware configuration for the system. In addition, the output is used to choose the most efficient manpower mix and cost changes in personnel policies, and to estimate budget costs of personnel policies.

DOCUMENTATION:
"Army Manpower Cost System (AMCOS)," ARI Research Focus, US Army Research Institute for the Behavioral and Social Sciences, June 1987.

ALTERNATIVE/COMPARABLE APPROACHES:
Navy Billet Cost Model

STAGE OF DEVELOPMENT:
Officer, enlisted, and civilian component life-cycle cost models are currently available. For information, contact: Mr. George Michael, US Army

Cost and Economic Analysis Center, ATTN: SFFM-CA-FI, 5611 Columbia Pike, Falls Church, VA 22041, (703) 681-3335.

COMMENTS:
AMCOS will soon be in a Windows format. AMCOS is available on the Net at:
http://www.asafm.army.mil/amcos/amcosweb/demo/descfram.htm

OVERALL CATEGORY: Analytic Technique
STATUS: Available

TITLE: Cognitive Neurometric System (CNS)

SPONSOR: Northrop Grumman/University of California, Los Angeles
POINT OF CONTACT: Mr James R Francis / 562-942-5347
EMAIL: jrfrancis@aol.com
RECORD NO.: HSI00093

GENERAL OVERVIEW:
The Cognitive Neurometric System (CNS) is an advanced, miniaturized, ruggedized portable electroencephalographic recording and analysis system used to objectively measure and quantify mental workload. A second use of the system is to measure an individual's state of alertness in real-time. This psychophysiological measuring system has been developed to operate in the hostile environment of military aircraft cockpits, and has been used in-flight on several USAF aircraft.

Additional applications of this technology are under development in the areas of candidate selection, fit-for-duty assessment, task adaptation, training progress assessment, and measurement of the effects of drugs, alcohol, stress, fatigue, and pharmacological agents.

APPROPRIATE USES:
1. Real-time monitoring of operator's state of alertness.
2. Objective measurement and quantification of mental workload in the performance of tasks.
3. Selection of candidates for technical task training.
4. Fit-for-duty assessment for drugs, alcohol, stress, fatigue or pharmacological agents.

EQUIPMENT REQUIRED:
The use of the CNS, which includes electrodes, pre/post amplifiers, power supplies, recording media, cables and the computer processing of brainwaves.

INPUTS REQUIRED:
The subject wears a customized skull cap with electrodes imbedded to pick up the subject's brain waves for on-line real-time monitoring, or for recording for later processing and analysis.

PROCESSING TECHNIQUES:
Proprietary hardware/software is used for on-line real-time monitoring and triggering of events, and for recording for later processing and analysis. The brain wave pick-up electrodes must be placed properly, and verification of electrical contact with the skin of the head is required.

OUTPUT:
The measurement and recording of brain waves which are processed and analyzed for determination of the mental workload of specific parts of the brain at specified times or for specific tasks. Those digitally recorded brain waves are processed and then analyzed through proprietary software analysis programs.

USES OF OUTPUT:
Real-time output signals are processed through pattern-matching techniques. When the pattern is recognized and a threshold is crossed, a signal is sent, identifying the condition, enabling the activation of alerting

systems. For workload assessments, the processed data shows the intensity of brain activity at selected sites, and when correlated with task performance, indicates the degree of brain engagement and the brain's reserve mental processing capacity at that site.

DOCUMENTATION:
Documentation will be provided with the CNS for the specific application.

References:

Sterman, Maurice B., Kaiser, D., Mann, C. & Francis, J., "Topographic EEG Correlates of the Basic Attributes Test for Air Force Candidate Selection," Proceedings, 36th Human Factors Society Annual Meeting, pp 62-65, Santa Monica, CA, Human Factors Society

Sterman, Maurice B., Kaiser, D., Mann, C. & Francis, J., "Electroencephalographic Correlates of Psychological Defense," Proceedings, 36th Human Factors Society Annual Meeting, pp 76-80, Santa Monica, CA, Human Factors Society

Sterman, Maurice B., Kaiser, D., Mann, C., Suyenobu, B.Y., Beyma, D.C. & Francis, J., "Application of Quantitative EEG Analysis to Workload Assessment in an Advanced Aircraft Simulator," Proceedings, 37th Human Factors & Ergonomics Society Annual Meeting, pp 118-121, Santa Monica, CA, Human Factors & Ergonomics Society

Veigel, B. & Sterman, Maurice B., "Topographic EEG Correlates of Good and Poor Performance in a Signal Recognition Task," Proceedings, 37th Human Factors & Ergonomics Society Annual Meeting, pp147-151, Santa Monica, CA, Human Factors & Ergonomics Society

Human Factors & Ergonomics Society Annual Meeting Proceedings, 1992 and 1993.

ALTERNATIVE/COMPARABLE APPROACHES:
Simpler methods are in use today (SWAT, evoked potentials, heart rate variability). However, these primitive methods do not provide the fidelity or reliability of the CNS, nor do they provide objective measures of mental workload.

STAGE OF DEVELOPMENT:
1. Monitoring of state of alertness - Ready for implementation
2. Objective measurement of mental workload - In use today
3. Candidate selection - Immediately available (must be tailored to the specific application)
4. Fit-for-duty - Immediately available

VALIDATION:
The Cognitive Neurometric System has been used in-flight in USAF T-38, C-130, NT-33, C-141, and B-52 aircraft. It has been used extensively in the B-2 Flight/Mission Simulator, and has been adapted for in-flight use on the B-2 (and other aircraft) to validate the aircrew workload.

COMMENTS:
Additional applications of the technology are under study. Contact the POC for status.

Additional MISSION AREAS served are: fit-for-duty determination; training progress assessment; candidate selection; operator/crew station design; and display design validation.

OVERALL CATEGORY: Analytic Technique
STATUS: Available

TITLE: Complex Cognitive Assessment Battery (CCAB)

SPONSOR: Naval Computer and Telecommunications Station (NAVCOMTELSTA)
POINT OF CONTACT: Ms Kathy Winter / 850-452-2601 x5531, DSN: 922-2601
EMAIL: k_winter_at_nctspens__n8@smtplink.ncts.navy.mil
RECORD NO.: HSI00009

GENERAL OVERVIEW:
CCAB contains nine tests of higher cognitive functions. The tests are: Tower Puzzle, Mark Numbers, Numbers and Words, Information Purchase, Route Planning, and Missing Items. The PC-based software features the capability of customized test configurations, menu-driven software, repeated measures, variable levels of difficulty, and automated scoring and reporting. CCAB is written in the C programming language.

APPROPRIATE USES:
The appropriate uses of CCAB vary with the user. For the military, CCAB can test the effects of battlefield stressors on cognitive performance. It also can test for differences in Military Occupational Specialty (MOS) requirements. For the academic, the repeated measures feature makes the CCAB ideal for drug or sleep-deprivation research. The CCAB also can be used for the basic investigation of higher cognitive functioning. For users in industry, CCAB's flexibility permits configuration of specialized batteries for jobs with different cognitive profiles. CCAB can be used in the health field as an aid for neuropsychological testing of higher cognitive functions.

EQUIPMENT REQUIRED:
The equipment required to use CCAB consists of an IBM compatible PC with at least 384K of memory, a hard disk, color display monitor, and graphics card.

INPUTS REQUIRED:
The inputs required to use CCAB include study design parameters the user provides via the CCAB setup feature. That feature prompts for subject code, which tests will be run, in what order, number of trials per test, number of seconds per trial, and whether instructions, a quiz, practice trials or feedback to the participant is wanted. The participants respond to stimulus events from CCAB on the monitor and respond appropriately by pressing predefined keys on the standard PC keyboard.

PROCESSING TECHNIQUES:
The processing of the input consists of the participant's responses being automatically saved to the hard drive. Traditional measures of response times and number correct and incorrect are provided by CCAB. Internal algorithms calculate synthesized measures of performance.

OUTPUT:
The output from CCAB consists of test results which may be viewed on the monitor or printed on paper. Results are available immediately upon completion of individual tests. Measures within tests are organized by trial. A between-test integrated summary combines key performance items across all the tests.

USES OF OUTPUT:
The format of the CCAB screen or paper printouts allows a quick

observational analysis of the output as a function of test variables. The data also are readily available for transfer to common statistical packages for formal data analysis.

DOCUMENTATION:
"Expanded Complex Cognitive Assessment Battery (CCAB): Final Test Administrator User Guide," US Army Research Institute, December 87.

"Expanded Complex Cognitive Assessment Battery (CCAB): Test Descriptions," U.S. Army Research Institute, March 88.

ALTERNATIVE/COMPARABLE APPROACHES:
None known.

STAGE OF DEVELOPMENT:
Fully mature. To obtain, write: NAVCOMTELSTA, Code N81 (Ms. Kathy Winter), 130 West Ave., Ste. B, Pensacola, FL 32508-5111, (904) 452-2601 / DSN 922-2601, ext. 5531.

VALIDATION:
CCAB has been validated. Validation information pertaining to certain groups may be available. Call the POC for more specific information.

COMMENTS:
The nine CCAB tests are based on the psychological literature. A full description of the background of each test is provided in the "Expanded Complex Cognitive Assessment Battery (CCAB): Test Descriptions" manual cited above.

OVERALL CATEGORY: Analytic Technique
STATUS: Available

TITLE: Continuous Safety Sampling Methodology (CSSM)

SPONSOR: University of Texas at El Paso
POINT OF CONTACT: Dr Rolando Quintana / 915-747-7990
EMAIL: quintana@vlobos.me.utep.edu
RECORD NO.: HSI00169

GENERAL OVERVIEW:
The Continuous Safety Sampling Methodology (CSSM) studies the system for occurrence of conditions becoming hazardous, and indicates what steps should be taken to eliminate these conditions when their occurrence crosses certain preset limits, or when they show an unnatural pattern. The concepts underlying this proactive approach to industrial safety are derived from work sampling and control chart theories. CSSM involves a planned, systematically organized, and before-the-fact process characterized as the identify-analyze-control method of safety. The CSSM enables timely identification and evaluation of the conditions becoming hazardous -- before losses occur.

Policing and inspection approaches aimed at enforcement of safety and health standards cannot generate effective preventive measures because they are episodic, external and coercive, rather than sustained, internal and self-governed; and they are often arbitrary and indifferent, rather than relevant and motivated. In essence, the CSSM is concerned with determining and maintaining a preset degree of safety, within the constraints of operational effectiveness, time, cost, and other applicable interfaces to safety that can be achieved throughout the life cycle of the system.

In CSSM, the safety status of a system is evaluated using dendritics -- the core conditions (reach, bending, lifting, etc.) leading to hazards in any given system.

The CSSM is a concept of providing safety condition information in a statistically verifiable and economically viable manner by using the principles of work sampling and control charts. The applied hypothesis is that a random sample of a sufficiently large size, as in work sampling, reflects the state of the system being observed. Further, the plotting of the attribute, namely the existence or potential for a hazard, could indicate whether the system is safe or not. Observations are plotted to obtain a safety control chart. If it is "under control" (i.e., there is no significant potential for a hazard), the sampling process is continued. However, if the control chart indicates that the system is "out of control" (i.e., there is sufficient potential for a hazard which could result in an injury), then proactive action should be taken to prevent an injury.

APPROPRIATE USES:
Used to analyze a system prior to failure and worker injury in order to check the system and prevent industrial injuries before the injuries can happen. CSSM is a generic tool, with applicability to any industry, either manufacturing or service orientation. It has the advantage of substantial cost reductions through its ability to statistically predict the tendency for hazards to occur in a given system. The CSSM may not be economical to implement in a system with a single operator or machine, or in a system with operators or machines located over large areas.

EQUIPMENT REQUIRED:

None.

INPUTS REQUIRED:
An analysis of the system using the Preliminary Hazard Analysis (PHA), which includes direct observation and sampling techniques. The effectiveness of the CSSM depends greatly on the developmet of dendritics -- core conditions (such as forward and/or backward bending and degree of movement) in a given system. Not all the dendritics for a given class of hazards may be known. A faulty sampling study may result in a wrong interpretation of the tendency of the system. Dendritics can be continuously improved by studies of the system from new perspectives.

PROCESSING TECHNIQUES:
1. Create sampling plan, where the core elements are various dendritics and no dendritics.
2. Determine sample size based on the confidence level and the desired accuracy.
3. Perform the random sampling, as scheduled, providing values for the CSSM control charts.
4. Create control charts based on observed samples.
5. If the control chart indicates a system "under control", keep sampling. If an "out of control" condition is detected, the system could be approaching a hazardous situation. Investigate and take corrective action.
6. After preventive steps are taken, recalculate the control limits for the control chart. Repeat steps 2-5 as appropriate.

OUTPUT:
Control charts which indicate whether a system is "under control" (not hazardous) or "out of control" (a hazardous situation is present).

USES OF OUTPUT:
Plot points on the control charts are used to determine whether the system and worker activities are within tolerance limits as displayed on the chart, or out of tolerance. If out of tolerance, the specific potential hazard can be determined from the charts and corrective action taken.

DOCUMENTATION:
"A Methodology for the Analysis and Prediction of Back Injuries in Apparel Manufacturing", proceedings, Human Factors and Ergonomics Society 41st Annual Meeting, 1997.

ALTERNATIVE/COMPARABLE APPROACHES:
The formal methods of hazard analysis can be devided into two broad categories: inductive and deductive. The inductive method forms the basis for such analysis as Failure Mode and Effect Analysis (FMEA), and Operation Hazard Analysis (OHA). These methods emphasize the mode of failure, the triggering event(s), and the ultimate impact on people and property. If inductive analysis details what can happen, deductive analysis informs how it happens. An example would be Fault Tree Analysis (FTA). It postulates failure of the entire system, and then identifies how they contribute to the failure. However, the formal methods are limited in their effectiveness, as they only come into the picture once an injury has taken place. They do not provide real-time information on whether the conditions in a system are becoming hazardous, which may finally lead to an injury or an occupational disease. CSSM provides information that the system under consideration is becoming hazardous.

STAGE OF DEVELOPMENT:
Available for use.

VALIDATION:
CSSM was successfully implemented in an apparel manufacturing plant, providing insights on how the system was becoming dangerous, and providing insights as to the reasons why. Paper (see DOCUMENTATION above).

COMMENTS:

OVERALL CATEGORY: Analytic Technique
STATUS: Available

TITLE: D-CIDER

SPONSOR: Cognitive Technologies, Inc
POINT OF CONTACT: Dr Marvin S Cohen / 703-524-4331
RECORD NO.: HSI00016

GENERAL OVERVIEW:
D-CIDER offers a more flexible alternative to standard decision models such as multi-attribute utility theory, which demands a large set of precise numerical assessments up front. D-CIDER is based on the philosophy that users may differ in what they know about what they want and in how they think about their preferences, and that their understanding may evolve as they work the problem. D-CIDER employs multiple strategies to assist the user in selecting decision options based on a multi-dimensional set of goals and preferences.

APPROPRIATE USES:
D-CIDER provides user-tailored support for selecting one or more options from a database, for example, personnel to hire, products to introduce, homes to buy, etc.

EQUIPMENT REQUIRED:
D-CIDER runs on IBM PC, AT, and PS/2 compatibles; it requires 256K of memory, an enhanced graphics adaptor, and RGB color monitor. The system is written in C and Halo. It utilizes standard dBASE III files containing the options to be evaluated and their descriptions.

INPUTS REQUIRED:
Users may express their preferences in any of a variety of ways: by setting goals on one or more dimensions, by specifying tradeoffs among criteria, and/or by directly evaluating a sample of the options. Tradeoffs can be expressed by partially or completely rank-ordering criteria, by specifying exact or inexact importance weights, and/or by assessing the importance of some or all attributes relative to a standard. The implications of inputs in any format are displayed in all the other formats.

PROCESSING TECHNIQUES:
D-CIDER provides the user a choice of decision strategies, but guards against potential pitfalls in the user-selected approach. For example, the "eliminate" strategy screens options by user-set goals in order of their importance; this strategy is quite natural, but it may eliminate too many or too few options. If either problem occurs, D-CIDER uses prompts and a flexible spreadsheet-type display to help users revise their goals. For example, it prompts if options have been rejected because they just miss a goal on one dimension but are outstanding in other respects. The "justify" strategy enables users to work backwards from a tentative choice, determining whether the choice could be justified in terms of its performance relative to other options. The "maximize" strategy utilizes whatever partial and imprecise tradeoff information the user has provided in order to calculate which options could be best. Users can employ multiple strategies, in any order.

OUTPUT:
D-CIDER provides a list of recommended options, based on user inputs and the selected decision strategy or strategies. The "maximize" strategy can be used to provide exact or inexact scores for each option; and the "justify"

strategy can be used to generate a rationale for the choice.

USES OF OUTPUT:
Varied.

DOCUMENTATION:
Cohen, Marvin S., Laskey, Kathryn B., and Tolcott, Martin A., "A Personalized and Prescriptive Decision Aid for Choice from a Data Base of Options," Technical Report 87-18, Reston, VA; Decision Science Consortium, Inc., December 1987.

ALTERNATIVE/COMPARABLE APPROACHES:
None known.

STAGE OF DEVELOPMENT:
A demonstration system has been completed, which implements a subset of the D-CIDER design. Limitations of the demonstration are: 1) it works with a maximum of seven criteria; 2) the capability for directly evaluating options is not yet implemented; 3) it still has a few bugs; and 4) the documentation is not yet complete.

For more information, contact: Dr. Marvin S. Cohen, Cognitive Technologies Inc., 4200 Lorcom Lane, Arlington, VA 22207. Phone: (703) 524-4331.

COMMENTS:
None.

OVERALL CATEGORY: Analytic Technique
STATUS: Available 3rd Quarter FY98

TITLE: Digital Anthropometric Video Imaging Device (DAVID)

SPONSOR: Naval Aerospace Medical Research Laboratory (Code 66452)
POINT OF CONTACT: Mr Jack L Saxton / 850-452-2557, DSN: 922-2557
EMAIL: jsaxton@namrl.navy.mil
RECORD NO.: HSI00164

GENERAL OVERVIEW:
The Digital Anthropometric Video Imaging Device (DAVID) is a computer-based method of obtaining conventional measurements of the human body. DAVID requires a computer, frame-grabbing hardware, digitizing software, and camera(s). An image of the person to be measured is acquired and digitized to obtain the measurement. Because DAVID is a computer-based system, the full potential of this technology is difficult to project; however, a few advantages of DAVID have been identified:

1) Flexibility: DAVID's images can be acquired at a remote location and sent electronically, using networking capabilities, to a central site for digitizing, quality control, storage, and entry into a database.

2) Compatibility: DAVID, in conjunction with modeling software, offers the capability of electronically transferring measurements in real-time applications for screening personnel and for design criteria.

3) Quality Control: DAVID, a computer-based system, accomodates review of files for not only accuracy of measurement, but also verification of proper subject positioning.

4) Portability: DAVID can be moved easily to sites where the subject population is located.

5) Graphic Report: A DAVID image file provides easily understood graphic representations of each measurement taken.

6) Inexpensive: DAVID's components are off-the-shelf items.

7) Minimal Training: DAVID requires manipulating a mouse controller to digitize and measure an image.

APPROPRIATE USES:
- Anthropometric personnel screening
- Anthropometric survey
- Garment design/fitting
- Human factors
- Design of transportation equipment, furniture, etc.
- Growth/weight-loss studies

EQUIPMENT REQUIRED:
- PC
- Frame-grabbing board
- Digitizing software
- One or more cameras

INPUTS REQUIRED:
The system must be calibrated before meaningful measurements can be obtained. Calibration is performed for each of the cameras by digitizing an

object of known dimensions that is also a known distance from the camera. The only other inputs required from the operator would be a file-naming system selection and a sequence of keystrokes/mouse operations to obtain and digitize the image.

PROCESSING TECHNIQUES:
Once the image is acquired, digitizing software is used to electronically measure the subject. Limits of the area to be measured are defined by moving the mouse cursor to the exact location to start the measurement, and then moving it to the location where the measurement is to terminate. The software automatically calculates distance (in trhe preferred units of measurement) based on the previously performed calibration. Each value can be electronically copied to a database for statistical analysis/evaluation and storage.

OUTPUT:
The output from DAVID is compatible with the Internet, network, hard copy, floppy disc, writeable CD, or any other media suitable for data transfer.

USES OF OUTPUT:
Since DAVID is computer-based, the output can be varied. Generally, a report containing the image with anthropometric measurements would be included in the most basic output; however, other outputs could include interfacing with 3-dimensional modeling software, or real-time anthropometric screening of personnel.

DOCUMENTATION:
Currently, DAVID's only technical references are the manuals associated with each individual component. Eventually, a complete operations manual will be created in order to provide instruction for the entire system.

ALTERNATIVE/COMPARABLE APPROACHES:
Currently, two major alternative approaches are available for obtaining anthropometric measurements. One is is the manual technique, which requires the use of anthropometers; and the second is a 3-dimensional laser scanning apparatus.

STAGE OF DEVELOPMENT:
DAVID technology has been developed to the point of completing two validation studies. Additional software development is needed to make the system more "user-friendly" toward manipulation of the image between different software programs, automatically transferring the data to a database, and producing reports.

VALIDATION:
Two validation studies have been completed to assess accuracy, reproducibility, and comparability of DAVID technology. One of these studies was designed to assess accuracy and reproducibility of the DAVID technique when compared with other methods of measurement. When sitting height was measured for one person by 15 different people using different measurement techniques, DAVID and the manual (anthropometer) techniques produced the same mean. In another study, eight measurements (sitting height, sitting eye height, sitting acromial height, thigh clearance, buttock/knee length, sitting knee height, hip width, and bideltoid breadth) were made on 240 people using both DAVID and manual techniques; the results showed a high level of correlation between the measurements. These studies provide verification that DAVID is a viable alternative to existing anthropometric measuring methodologies.

COMMENTS:

Other POC: F. R. Patterson, LCDR, MSC, USN
Com.: 850-452-4656 / DSN 922-4656
E-mail: patterso@namrl.navy.mil
(Same address as above.)

OVERALL CATEGORY: Analytic Technique
STATUS: Available

TITLE: Estimating Predictive Validity When Range Restriction Due to Selection and Attrition Is Present

SPONSOR: Navy Personnel Research and Development Center
POINT OF CONTACT: Dr Jules I Borack / 619-553-7641, DSN: 553-7641
EMAIL: borack@nprdc.navy.mil
RECORD NO.: HSI00105

GENERAL OVERVIEW:
This technique estimates the predictive validity of test scores when range restriction due to selection and attrition is present. A percentage of students academically attrite from Navy training schools and receive no final grade. Exclusion of these individuals from predictive validity and other statistics yields estimates based on a non-random sample of selectees. A technique was developed for imputing a final grade for selectees who do not complete a course so that they can be included in validation analyses. The methodology was based on a mathematical model in which the grades of course completers were distributed as the sum of truncated normal and normal variables. Another methodology, based on Guilford Case III and Guilford Case I corrections (Guilford, 1965), was also considered. The accuracy of these techniques was estimated using data from a variety of simulated school scenarios.

APPROPRIATE USES:
To estimate the predictive validity of tests when selection bias is present and non-random attrition occurs.

EQUIPMENT REQUIRED:
This procedure must be programmed. Hardware requirements are minimal and are dependent on the size of test database.

INPUTS REQUIRED: Observed test scores
Proportion not completing course for academic reasons

PROCESSING TECHNIQUES:
1. Estimated final grades for academic non-completers are obtained.
2. Estimated validity for selectees is determined.
3. Estimated validity for applicants/general population is determined.

OUTPUT: Estimated final grades for academic non-completers
Adjusted test validity

USES OF OUTPUT:
To determine the effectiveness of test procedures.

DOCUMENTATION:
Borack, J. I. (1994) Estimating Predictive Validity When Range Restriction Due to Selection and Attrition is Present, Military Psychology, 6(3) 193-204.

ALTERNATIVE/COMPARABLE APPROACHES:
Abrahams, N. M. , Alf, E. F. & Neumann, I (1993), The Treatment of Failures in Validation Research. Guilford, J. P.(1965), Case III validation correction.

STAGE OF DEVELOPMENT:
Published technique.

VALIDATION:
Simulation reported in Military Psychology 6(3).

COMMENTS:
None.

OVERALL CATEGORY: Analytic Technique
STATUS: Available

TITLE: HARDMAN Comparability Methodology (HCM)

SPONSOR: Dynamics Research Corporation
POINT OF CONTACT: Mr Richard Adkins / 978-475-9090 x1258
EMAIL: radkins@drc.com
RECORD NO.: HSI00002

GENERAL OVERVIEW:
HARDMAN is an analytic approach for early manpower, personnel, and training (MPT) estimation based on a technique which uses knowledge about similar existing systems and technological growth trends to project the MPT requirements of proposed new systems.

APPROPRIATE USES:
This method is appropriate for developing a structured comparability analysis. HARDMAN is most useful in the development of systems, but may be applied to Product Improvement Program (PIP) systems, as well as Non-Developmental Item (NDI) systems. It is most useful pre-Milestone I; however, it has utility through Milestone III.

EQUIPMENT REQUIRED:
The equipment required for this method is a calculator or, preferably, a PC (for multiple applications or large systems).

INPUTS REQUIRED:
The input for this method includes: (1) missions, functions, and subfunctions; (2) equipment and usage rates; (3) reliability and maintainability (RAM) data; (4) transients, trainees, holdees and students (TTHS); and (5) training, promotion, attrition, migration data.

PROCESSING TECHNIQUES:
The processing of the input involves data conversions to an appropriate format for use with a calculator or PC.

OUTPUT:
The output from this method includes: (1) an estimation of workload; (2) manpower requirements by military occupational specialty and paygrade; (3) personnel flow rates; and (4) training resource requirements.

USES OF OUTPUT:
The output is used to project MPT requirements and especially to identify potential problem areas.

DOCUMENTATION:
"HARDMAN Comparability Analysis Methodology Guide," 5 vols., ARI Research Product 85-19 through 85-23, ADA156787 through ADA156791, US Army Research Institute for the Behavioral and Social Sciences, May 1985.

Zimmerman, W., Butler, R., Gray, V., Rosenberg, L., and Besser, D., "Evaluation of the HARDMAN (Hardware vs. Manpower) Comparability Methodology," ARI Technical Report 646, August 1984.

ALTERNATIVE/COMPARABLE APPROACHES:
HARDMAN II.3; HARDMAN III

STAGE OF DEVELOPMENT:

This method is fully mature in that it has been applied to about 20 Army systems. Those systems include DSWS, CS, ESPAW, ASAS, AGS, Hawk, (PIP-III), Air Defense Systems, ETAS, STINGRAY, LADS, LHX, Patriot, SP York, SHORAD C2, AFATADS, LRAT, and FAALS.

The HARDMAN Guide is available from the Defense Technical Information Center, Reference and Retrieval Division, ATTN: DTIC-BR, 8725 John J Kingman Rd, Ste 0944, Ft Belvoir, VA 22060-2185, (703) 767-8274 / DSN 427-8274.

Documentation of HARDMAN utility can be obtained from the U.S. Army Personnel Integration Command.

For more information about HARDMAN Comparability Methodology (HMC), contact:

Dynamics Research Corporation, Systems Div., Dept 44
Attn: Mr Richard Adkins
60 Frontage Rd
Andover, MA 01810
Phone: (508) 475-9090, extension 1258.

COMMENTS:
The cost to use this method for a single system is approximately three person-years, but varies according to system size and complexity, accessibility of data, experience of analysts, and scope of analysis, etc. A fairly large (more than ten) team of interdisciplinary analysts is required at various times throughout the analysis. Data collection is often difficult and time-consuming. Cost of data collection can be 40% of total cost of a HARDMAN analysis, depending on data accessibility.

OVERALL CATEGORY: Analytic Technique
STATUS: Available

TITLE: Parameter Assessment List - MANPRINT Automated Tool Edition (PAL-MATE)

SPONSOR: Army Research Laboratory (ARL/HRED)
POINT OF CONTACT: Dr Donald B Headley / 410-278-5834, DSN: 298-5834
EMAIL: dheadley@arl.mil
RECORD NO.: HSI00078

GENERAL OVERVIEW:
To support the assessment process of MANPRINT's newest domain, called Soldier Survivability, the Army Research Laboratory's Human Research and Engineering Directorate and Survivability/Lethality Analysis Directorate have developed an assessment guideline, referred to as the Parameter Assessment List (PAL). The List consists of rating sheets which outline a series of issues under each of six broad categories. This methodology is currently a paper-and-pencil process. The completion of the rating sheets can be a time-consuming and onerous process. An automated version would alleviate these problems. Additionally, because multiple agencies contribute to an assessment, an automated format would provide more conformity in domain report assessment and preparation. The PAL-MATE is a PC-based automated version of the PAL. PAL-MATE, like the manual PAL, is a comprehensive accounting of what to rate, but not how to rate it.

APPROPRIATE USES:
PAL-MATE is intended for performing Soldier Survivability (SSv) domain assessments.

EQUIPMENT REQUIRED:
IBM-compatible with at least 386 CPU, 4 megabytes RAM, hard disk drive with 15 megabytes of free space, Windows 3.1 (or higher).

INPUTS REQUIRED:
The analyst rates each SSv issue according to a Severity Scale of N/A (not applicable), None, Minor, Major, and Critical (the rating is entered by clicking on the appropriate scale item). Text pertaining to a given issue can be entered into a Comments box.

PROCESSING TECHNIQUES:
PAL-MATE is coded in Borland C++. SSv issues are rated one at a time. The tool's features include: a) a user-friendly front-end interface; b) a menu to easily select a given portion of the PAL to work on; c) rating sheet screens which allow easy cursor maneuverability; d) navigation aids which tell the user where he is in the system; e) embedded user guide with table of contents which allows section selection; f) provision for easy changes to be made to the issues contained in the rating sheets (additions, deletions, edits); g) roll-up of information from the issue level to the component-level summary sheets; h) search; i) glossary; and j) report generation.

OUTPUT:
A screen or paper report sorts the ratings of SSv issues by the Severity Scale of N/A, None, Minor, Major, and Critical. Any accompanying comments are also attached to each issue.

USES OF OUTPUT:
The assessment of each SSv Component is sent to the Integration Office of

SLAD for roll-up into a SSv Domain Report.

DOCUMENTATION:
PAL-MATE User's Guide.

ALTERNATIVE/COMPARABLE APPROACHES:
Procedures Manual for Soldier Survivability Assessments, May 1994 (paper-and-pencil manual version).

STAGE OF DEVELOPMENT:
Available 1FQ96.

To obtain, write: Director, U.S. Army Research Laboratory
ATTN: AMSRL-SL-BG (Richard Zigler), Bldg. 247
Aberdeen Proving Ground, MD 21005-5068

COMMENTS:
Distribution is unlimited for DoD and US DoD contractors. Some distribution restrictions may apply to organizations outside of DoD. Please contact the POC for an availability determination.

OVERALL CATEGORY: Analytic Technique
STATUS: Available

TITLE: Requirements Management Strategy (RMS)

SPONSOR: Naval Air Warfare Center - Weapons Div (NAWCWPNS)
POINT OF CONTACT: Ms Gene Schneider / 619-939-9755, DSN: 437-9755
EMAIL: gene_schneider@MLNGWW.chinalake.navy.mil
RECORD NO.: HSI00090

GENERAL OVERVIEW:
The Requirements Management Strategy (RMS) is an integrated system to capture, control, and communicate project requirements, including change management and metrics. It specifically supports the "world views" of sponsors, users, system engineers and software engineers.

The Strategy consists of:

1. Three tailored MIL-STD-2167 requirements documents:
   - Document A: for sponsor/manager & operator/user views.
   - Document B: for the system engineering view, including allocation of requirements to test modes, media (hardware, software, and liveware), and subsystems.
   - Document C: for the subsystem/software engineering view.

2. Two databases:
   - Requirements tracking/documentation database (called RAT)
   - Functional Hierarchy database *

3. Three implementing processes:
   - Project Specification (Project Development Phase 1)
   - System Requirements Analysis (Phase 2a)
   - Software Requirements Analysis (Phase 2b)

* All documents, and the requirements database, are required to be organized according to the Functional Hierarchy for the project, for the project, which is developed and approved in the Project Specification phase.

APPROPRIATE USES:
RMS is used to manage all aspects of project requirements, including documentation, dissemination, traceability, and change control.

The method was designed for projects that use the system development MIL-STD, specifically post-deployment aircraft projects. But the method is both generic and flexible, and is not constrained for use only with military systems.

EQUIPMENT REQUIRED:
The method does not require particular hardware or software. The current implementation uses:
1. WORD for documents, memos, etc.
2. FileMaker Pro for databases.

These applications operate on both Macintosh and PC computers.

INPUTS REQUIRED:
System/project requirements, in any form in which they may exist.

Functional Hierarchy for the system/project, that is:
1) complete (there is a place in it to put each requirement); and
2) non-redundant (there is exactly one such place).

Results of various analyses, such as how requirements will be tested, and allocation of requirements to subsystems.

PROCESSING TECHNIQUES:
For the requirements database, considerable analysis must be done to determine the boundaries between one requirement and another, and what parts of the requirement definition belong in the name, description, implementation, and comments fields in the database. The requirements must be given unique identifiers, consisting of a Functional Hierarchy ID and a "sequence number" to order the individual requirements assigned to each hierarchy item.

OUTPUT:
Requirements documents
Requirement traceability tables
Other special RAT outputs (such as presentation slides)

USES OF OUTPUT:
Provide information needed to complete all activities associated with requirements management for a project: analysis, documentation, dissemination, traceability, and change control.

DOCUMENTATION:
"Requirements Management Strategy," (IEEE presentation), NAWCWPNS (C2103), China Lake, CA, May 94.

"Requirements Documents in the Context of the Requirements Management Strategy (RMS)," NAWCWPNS (C2103), China Lake, CA, April 94.

ALTERNATIVE/COMPARABLE APPROACHES:
The MIL-STD for software development (MIL-STD-2167) is an alternative. The Software Engineering Institute (Carnegie Mellon University) Capability Maturity Model, Requirements Management Key Process Area is another alternative. Projects developed according to the RMS method can be completely compliant with the requirements of both of these alternative methods. As said above, the RMS method is generic and flexible.

STAGE OF DEVELOPMENT:
The method is fully operational. Like all TQM methods, it is continually being improved.

Hard copies of the references, and soft copy of document and database templates, are available from the POC. Contact Ms. Eugenia Schneider, Code C2193, Naval Air Warfare Ctr - Weapons Div, China Lake, CA 93555-6001, telephone 619-939-9755 / DSN 437-9755.

COMMENTS:
See HSI record number 92 for a more detailed description of the requirement database (RAT), and the Functional Hierarchy database that supports it.

OVERALL CATEGORY: Analytic Technique
STATUS: Available

TITLE: Test Planning, Analysis, and Evaluation System (Test PAES)

SPONSOR:
POINT OF CONTACT: Dr Valerie J Gawron / 716-631-6916
EMAIL: gawron@calspan.com
RECORD NO.: HSI00180

GENERAL OVERVIEW:
Test PAES is an integrated set of commercial off-the-shelf and custom software. The software includes databases, test planning guidance, and multimedia analysis tools. These tools were designed to make testing more efficient. For example, it contains, in digital version, the best test practices of experienced personnel. It runs on personal computers (PC), making the system available to the vast majority of test and evaluation personnel. Test PAES has four components: 1) a Structured Test and Evaluation Process (STEP); 2) a set of databases containing both reference material and test-specific information; 3) a set of Structured Test Procedures (STP); and 4) custom software to integrate these tools in a seamless system using commercial off-th-shelf (COTS) hardware and custom software.

APPROPRIATE USES:
Developing test plans; monitoring, analyzing, verifying, and reducing data; reporting results.

EQUIPMENT REQUIRED:
486/33 MHz system; 8 MB RAM; 80 MB hard disc; sound card; motion video board; Microsoft Windows, Microsoft Excel, Microsoft Word, Microsoft Access, Microsoft Video for Windows

INPUTS REQUIRED:
Excel file with time and parameter values; digital recorders and VHS video recorders; instrumented vehicles and ranges; data collection form/instrument -- Test PAES enables user to format data compatible with local use.

PROCESSING TECHNIQUES:
Test PAES includes a formatting tool to process engineering data and time synch those data with digitized video. Test PAES is used to complete time history analysis of test data. This includes comparison between multiple test runs, calculation of additional parameters, and creating X-Y plots. All analyses are performed from within Test PAES with support from a graphical user interface (GUI).

OUTPUT:
Test PAES is used to generate test plans, develop plots (e.g., time history, static X-Y, etc.), create multimedia presentations of the results, and query databases for information on test guidance, previous test reports, and meaning of scientific and technical terms.

USES OF OUTPUT:
The output is used to plan and conduct tests, support data reduction and analysis, and present results.

Analyst should have a Bachelor's degree in math, science, or engineering, 1 yr. experience, and 4 hrs. training on tool.

DOCUMENTATION:
The software user's guide is provided on the CD with Test PAES software. There is also extensive online help.

Gawron, V.J., Joseph, T.J., and Jeziorowski, M.M., "A PC-Based Test and Evaluation Tool", in Journal of the International Test and Evaluation Association, 37-41, March/April, 1998.

ALTERNATIVE/COMPARABLE APPROACHES:
No other tools have Test PAES' breadth and depth.

STAGE OF DEVELOPMENT:
Test PAES 4.2 was released 22 Sept. 1997. Planned upgrades include upgrading to Windows 98. The software may be obtained from the POC.

VALIDATION:
Mesiah, C. and Gawron, V., "Preliminary Functional Test Reports for the Test Planning, Analysis, and Evaluation System (Test PAES)", Calspan Report No. 8184-2, April 1994.

Gawron, V.J., "Operational Test for the Test Planning, Analysis, and Evaluation System (Test PAES)", Calspan Report No. 7738-26, February 1994.

COMMENTS:
Test PAES is currently installed at over 70 sites throughout the DoD, DoT, academia and industry. Training is available at the user's site.

For more information contact: Bart van Roekel
Noldus Information Technology, Inc.
6 Pidgeon Hill Dr., Ste 180
Sterling, VA 20165
Voice: 703-404-5506

OVERALL CATEGORY: Analytic Technique
STATUS: Available

TITLE: Timeline Management Tool (TMT)

SPONSOR: Air Force Research Laboratory
POINT OF CONTACT: Mr Dave G Hoagland / 937-255-4046, DSN: 785-7593
EMAIL: dhoagland@falcon.al.wpafb.af.mil
RECORD NO.: HSI00181

GENERAL OVERVIEW:
The crew system design state-of-the-art under-exploits analysis, partly because the available techniques lack persuasive evidence of the value added. Consequently, crew system designers now emphasize mock-ups and operator-in-the-loop simulation, and not analysis. By analytically deriving and comparing design concepts, designers can improve product quality, while lowering cost, by substituting inexpensive analysis for more costly simulation, and making better use of engineering simulator recources.

In tandem with a crew-centered design process and other software tools, a new Timeline Management Tool (TMT) for crew system analysis is now available. Analysis has a prominent place within the new design process, similar to the prominent role that analysis serves in other engineering disciplines.

The TMT's primary goals are: (1) to help analytically derive functional and information requirements for crew system design; and (2) to help reduce the design space by screening alternative design concepts. This is approached by converting a system mission timeline into a crew-member task timeline, and then analyzing the time-based events against a comparability baseline. TMT users can create:

- Crew System Definition Databases
- Mission Scripts
- Function Allocation Concepts
- Decomposed Task Timelines
- Task & Workload Analysis
- Action/Information Requirements

APPROPRIATE USES:
TMT was designed to support the Requirements Analysis activities of the crew-centered system design process (CSDP) developed by the Crew-Centered Design Technology (CCDT) Program. TMT specifically supports the following CSDP activities: Mission Analysis, Function Analysis, Function Allocation Analysis, Action/Information Requirements Analysis, and Preparation of a Notional Baseline.

TMT is used to support Mission Analysis by housing the mission event timeline, mission script, and mission narrative. The mission provides the context in which the crew system requirements are derived. TMT provides a means for initializing the traceability of mission requirements to crew system requirements, while also databasing missions for reuse by other crew system projects.

During Function Analysis, the crew system analyst identifies and describes the functions that support the execution of the mission phases. During this activity, the crew system analyst continues decomposition of mission phases to identify lower levels of mission functions. For each mission function, the crew system analyst investigates and assesses its characteristics, the

criteria for its successful execution, and its contribution to the ultimate success of phase goals and objectives.

During Function Allocation analysis, the crew system analyst allocates functions identified and analyzed during function analysis to the appropriate crew system sub-systems or to the crew member. Potential deficiencies in the baseline system are identified through the analysis of the function allocation. Initial function allocation analysis is conducted to assess the applicability of the comparability baseline system to adequately support the execution of mission functions. As deficiencies in the baseline system are identified, alternative allocations are proposed and assessed.

Action/Information Requirements analysis is performed for the purpose of generating requirements supporting the development of controls and displays. This activity is performed within the context of the mission requirements established during mission analysis activities. The output of this activity is used to support: (1) the development of baseline and enhanced crew system design mechanizations for rapid prototyping; and (2) the traceability of design decisions for specific crew system mechanizations.

The objective of preparing the notional baseline is to produce an initial crew system description or definition document containing the crew system philosophy statement, crew system design drivers, baseline crew system envelope, functional requirements of the comparability baseline, and description of the relevant technologies. TMT supports this activity from its crew system definition database and function attributes defined by the crew system analyst in the previous set of activities.

EQUIPMENT REQUIRED:
PC-DOS or MS-DOS operating system, Version 3.3 or above; Intel 486/66 processor or higher; minimum 16 MB RAM; 30 MB hard drive; MS Windows 3.1, Windows NT 3.5, 3.5" high-density disc drive.

INPUTS REQUIRED:
The data is hand-entered by the user, capturing the decomposition and derivation of requirements as developed through the course of a CSDP Requirements Analysis activity.

There are a number of recommended analytical techniques to support the Requirements Analysis activities. Currently, Cognitive Task Analysis (CTA) techniques have been applied to crew system requirement derivation. CTA techniques, such as concept mapping, Subject Matter Expert (SME) interviews, and Critical Decision Analysis were performed, and the results were hand-entered into the appropriate TMT data fields.

SMEs, or Domain Experts, are the primary source for obtaining the required knowledge in order to derive mission-specific data. However, TMT also databases all mission, function, task, information, and crew system definition data. Therefore, this data is available and reusable for initial population of a new project. Mission timeline data can be derived from SMEs and hand-entered, or another tool, called the Extended Air Defense Simulator System (EADSIM) may be used to generate a tab-delimited file of time-tagged events. Performance data is also collected from operator-in-the-loop simulation evaluation. This data includes: timing, subjective workload, and physiological measures.

Operator-in-the-loop simulation data requires some form of simulation software and the ability to collect timing and physiological measures. This

data is not necessary to use TMT.

PROCESSING TECHNIQUES:
TMT can read a tab-delimited file. This file is usually generated by a mission analysis tool, and contains time-tagged events. This file is not necessary as input to TMT for further analysis. In many cases, it is easier to manually enter the data.

Crew System Definition Database: As crew system design concepts develop for each project, TMT users can create and update a crew system computer database. This database supports design decisions about crew size and complement, along with associated sub-systems and components (such as controls and displays), while tracking the component design decisions relative to the evolving crew system configuration.

Mission Scripts: The TMT concept is based on a detailed mission event timeline, which depicts the time sequence of system events, as the operational scenario unfolds for the mission. That mission event timeline can be computer-generated or developed manually. Typically, the TMT user imports an event timeline from a mission planning software tool. TMT allows the user to generate specific objectives (that link design requirements to time constraints) and scenario scripts. The mission scripts offer context for crew system analysis.

Decomposed Task Timelines: The TMT accomodates up to ten levels of decomposition, eliminating reliance on a forced hierarchy of functions, sub-functions, and tasks. This permits decomposing a task timeline to granular levels (e.g., actuating a control switch). For simplicity, events, functions, sub-functions, and tasks are called "nodes". TMT allows the user to edit an existing timeline, to add, delete, copy, move, or paste a new node orsub-node, to copy nodes and sub-nodes, and to move nodes. Additionally, TMT responds to node search queries, edits node parameters, modifies node types, searches a timeline to locate a specified node or sub-node, and prepares timeline reports.

Function Allocation Concepts: TMT users can analytically generate and assess function allocation concepts in terms of the mission scripts. Because the TMT databases all timeline data, users can iteratively analyze the crew system functions (and corresponding crew system concepts), as is good design practice, but without the time consumed in constructing mock-ups or preparing simulators.

Task & Workload Analysis: For each crew member task in the task timeline, TMT users can define attributes, such as task duration, precedence, criticality, and "channel" activity. The resulting database can be used to estimate the crew workload. Several computer analysis tools are available for that purpose, or the user can also analyze workload within TMT.

Action/Information Requirements: TMT supports data development for crew member action/information requirements, for detailed information analysis and control design. For each task in the task timeline, TMT stores specific parameters for the action/information requirements, including measures and criteria.

Reporting: TMT offers a host of hard-coded report formats for reviewing and assessing the data in the database. The user may also purchase InfoMaker software to make custom reports, obtaining complete database reporting flexibility.

OUTPUT:
The final products or outputs from the use of this tool include a series of hard-coded reports. The TMT "Report" menu gives users three options for generating reports: Update DB for External Report Generator; Create Text Report; and Create Graphic Report. "Update DB for External Report Generator" updates the timeline database so it can be used with InfoMaker 4.0 to generate reports. InfoMaker software allows the user to customize reporting options. "Create Text Report" allows the user to generate and preview the available hard-coded text reports: Crew System Definitions, Timeline, Timeline Report w/ Notes, Mission Scripts, Function Attributes, Task Attributes, Information Requirements by Function, Information Requirements by Function Category, Information Requirements by System, Information Requirements Assessment by System, and Information Requirements Assessment by Function.

Crew System Definitions: This report prints out the contents of the Crew System Definition Database by the following options: crew member (one or all), function category, (one or all). The following options can be selected to be printed out: function capability, system, system capability, controls, control capability, display, and/or display capability.

Timeline Report: This report prints out the following fields of the Timeline at a specified level of decomposition: time, ctrl # (control number), description, and crew member.

Timeline Report w/ Notes: This report prints out the following fields of the Timeline, including notes, at a specified level of decomposition: time, ctrl #, description, and crew member. Notes are printed after their respective node.

Mission Scripts Report: This report prints out the mission scripts (objectives and script) for each phase node in the timeline.

Function Attributes Report: This report prints out each node in the timeline with its respective function attributes (if defined) by the following options: crew member (one or all), function category (one or all), OR timeline sequence. The following options can be selected to be included in the report: time, ctrl #, function objective, measures, criteria, and/or crew member.

Task Attribute Report: This report prints out each node in the timeline with its respective task attributes (if defined) by the following options: crew member (one or all(, function category (one or all), OR timeline sequence. The following options can be selected to be included in the report: task objective, task duration, standard deviation, task type, criticality, task precedence or continuous task time, and measures.

Information Requirements by Function: The objective of printing this report is to look for and verify the defined information elements. The user is making sure that all function requirements have defined information elements. The information is sorted and reported by the following sequence: time, ctrl #, node description, then information element.

Information Requirements by Function Category: The objective of printing this report is to assess the type of information required for different functional areas. This type of reporting supports development of integrated display designs. The information is sorted and reported by the following sequence: function category, information element, information requirement, function (node, ctrl #, description).

Information Requirements by System: The user is looking for either systems with unassigned information requirements or information requirements that have not yet been assigned to a system control or display. The information elements unassigned to a system are printed first. The following options can be selected to be included in the report: information requirement, system, controls, displays, and/or function requirements.

Information Requirements Assessment by System: The user is looking for deficient management of information requirements by either a baseline or enhanced crew system. The information is sorted and reported by information element, deficiency, system, control, then display. The unassigned information elements are printed first.

Information Requirements Assessment by Function: The user is looking for deficient management of information requirements by either a baseline or enhanced crew system. The information is sorted and reported by function, information element, then deficiency.

"Create Graphic Report" allows the user to generate and preview the task loading of a mission event/function sequence.

Task Loading Report: This report graphically displays the duration, start, and stop times of each node in a timline to indicate the task loading of a crew member. The task loading information can be sorted and reported by crew member (one or all), and/or "channel of activity" (e.g., visual, psychomotor).

USES OF OUTPUT:
Thid tool was specifically designed to support the Requirements Analysis and Predesign activities that are performed during crew system design. The output from this tool is the input for deliverable reports justifying crew system requirements.

Analyst requirements: B.S. degree in Human Factors; 2-5 yrs. HFE crew system design experience; 4 hrs. training on tool.

DOCUMENTATION:
Veda, Inc. (1996), "Crew-Centered Design Technology (CCDT) Program Timeline Management Tool (TMT) User's Manual", Document No. 63318-96U/P60099, Contract No. F33615-92-C-5936, Armstrong Laboratory, Air Force Materiel Command (Human Systems Center), Wright-Patterson AFB, OH 45433, Dayton, OH: Veda, Inc.

ALTERNATIVE/COMPARABLE APPROACHES:
None.

STAGE OF DEVELOPMENT:
Latest version is 2.5; no planned upgrades; software available through POCs.

VALIDATION:
TMT was verified through its application and upgrade in three Field Demonstrations (example, crew system design-type problems). Three final reports were documented, and are available through the POCs.

COMMENTS:
Alternate POC: Ms. Cindy D. Martin, 5200 Springfield Pike, Ste. 200, Dayton, OH 45431-1289, 937-476-8849/DSN 785-8849/FAX 937-476-2900, E-mail: cmartin@dytn.veridian.com, Website: www.veridian.com.

OVERALL CATEGORY: Analytic Technique
STATUS: Available

TITLE: Training Delivery Assessment Model (TRADAM)

SPONSOR: Chief of Naval Operations (CNO N75)
POINT OF CONTACT: CDR K W Fuchs / 407-380-4623, DSN: 960-4623
EMAIL: kw_fuchs@ntsc.navy.mil
RECORD NO.: HSI00166

GENERAL OVERVIEW:
With declining resources available to support training, the Navy is challenged to apply appropriate advanced training delivery technologies to traditional training environments to produce efficiencies without compromising training effectiveness. The judicious selection of appropriate training delivery technologies will allow initial investment costs to be offset by longer-term Navy cost avoidances. Navy cost avoidances can be anticipated from decreased student travel and per diem costs, reduction of shore-based schoolhouse infrastructure costs, reduction of student and instructor costs, etc., as a result of this infusion of advanced training delivery technology. As important as resource efficiencies are in evaluating training technology options, training quality improvement is the primary reason to employ technology for training delivery and training management in a course. Fortunately, improving training quality usually improves training efficiency.

Three Phases of the Model -- TRADAM views the training delivery technology selection process as consisting of three phases: (1) selection of candidate courses that have the most potential for advanced training delivery technology application; (2) assessment of training delivery technology alternatives that match the learning requirements of each candidate course; and (3) economic analysis of training delivery technology alternatives.

TRADAM was designed to be modular in its application. The three TRADAM modules, corresponding to the three phases of the training delivery technology selection process, can be applied independently. If candidate courses are already selected, Phases 2 and 3 can be applied without Phase 1. The economic analysis process (Phase 3) can be applied alone following a thorough analysis of training system requirements.

Phase 1: Selection of Candidate Courses

The first phase of the TRADAM process focuses on quickly identifying the best candidates for application of advanced training delivery technologies among the organization's formal resident training courses. This approach was adopted to ensure that the labor-intensive learning requirements analyses and economic analyses were performed only on the courses that have the most potential for cost avoidances.

Training cost avoidances can result from: (1) exporting training to the trainee's work site, thus saving travel time, travel costs, and per diem costs; and/or (2) shortening/compressing the training pipeline so the trainee spends less time in a training status (reduced training days lead to reduced training costs). TRADAM uses student throughput and course length as early discriminators in selecting courses to assess for technology infusion, since they tend to be the largest training cost drivers, whether a course is exported or compressed. Cost avoidances may also occur from decreasing consumables used during training (reducing paper/publishing costs), and from reducing wear and tear on operational equipment; but TRADAM does not

routinely use these cost avoidance categories as early discriminators.

The caracteristics of courses that are good candidates for exportability are different from the characteristics of courses that are good candidates for cost avoidance through course compression/shortening. TRADAM addresses these two situations separately.

Phase 2: Assessment of Training Delivery Technology Alternatives

For each course that is selected as a candidate for the application of advanced training delivery technology, the next step is to identify all appropriate training delivery technologies that will satisfy the training requirement(s) while also contributing to training efficiency. This second phase requires a detailed assessment of training delivery technology feasibility for each of the lessons taught in the course. The process collects information about the current training, determines the type of learning involved, and identifies requirements for the student interface with the instruction/training content.

Different types of learning require different types of instructional interactions. Each lesson/unit of a candidate course, therefore, must be examined to determine the types of learning that are required by the lesson objectives. TRADAM uses a classification scheme derived from one described by Gagne and Briggs (1974). Gagne and Briggs define five general classes of learned capabilities (intellectual skills, cognitive strategies, verbal information/verbal knowledge, motor skills, and attitudes). The instruction for each of these five general classes would follow different instructional strategies and incorporate different instructional activities. The identification of appropriate training delivery technologies for three of these classes of learned capabilities (intellectual skills, cognitive strategies, and verbal information/verbal knowledge), however, depends on similar factors. These factors include the student interface with the learning content (amount and nature of stimuli and feedback), the amount and nature of interactivity between students required, and the visual representations required (2D/3D, static/dynamic, etc.). TRADAM uses a simplified classification scheme, differentiating between only three general learning types that are relevant to the selection of training delivery technologies. The three general domains of learning considered by TRADAM during this process are: (1) intellectual skills (which includes Gagne and Briggs' intellectual skills, cognitive strategies, and verbal information); (2) physical skills; and (3) attitudes.

Phase 3: Economic Analysis of Training Delivery Technology Alternatives

The economic analysis of alternative training delivery technology solutions requires an assessment of both the value of resources required to support each alternative (costs) and the benefits (cost avoidances or savings) derived from each alternative being considered. Relative training efficiency, the comparison of the costs and benefits of a training technology alternative, is the primary consideration here. The cost of each training delivery technology alternative is analyzed in terms of investment costs and annual recurring costs. The relative benefits/savings resulting from using a particular training delivery technology to accomplish specific training goals are quantified by estimating those costs attributed to implementing the current training delivery that would be eliminated or reduced by implementing the training delivery technology alternative.

Training Delivery Technology Options

The training technologies that are described under this section are technologies that have been proven in actual military training settings to increase training efficiency by: (1) reducing the need for travel/per diem costs associated with TAD training by exporting the training to the student's job site/home port; (2) reducing training costs by compressing the time required to train; or (3) reducing other costs associated with training (e.g., reducing/eliminating printing costs by use of electronic media). Since these training technologies have been implemented in military settings, policy, standards, and guideance presently exists for their use in most cases.

Course Compression Training Delivery Technologies

Current Navy resident training is often characterized by an instructor lecturing from a paper instructor's guide. The instructor's lecture is supported by standard visual aid materials consisting of slides, transparencies, chalk boards, white boards and markers, and newsprint. The student takes notes in the paper trainee guide. Major limitations of the current paper-based training media are: (1) existing media do not show motion, a concept critical to understanding the way mechanical, hydraulic, and electrical components operate; (2) lack of student and instructor accessibility to electronic reference data; (3) costs associated with revising and printing paper-based course materials; and (4) lag time involved to revise paper-based materials (the technical documentation used in the school house is, therefore, often different from the technical documentation used in the fleet).

Course compression technologies are used to enhance the traditional classroom environment to enable students to meet the instructional objectives in less time. Course compression technologies include: Automated Electronic Classrooms (classrooms enhanced with various technologies to increase effectiveness of instructional presentations, increase amount of monitored student practice, increase the accessibility of technical information, enable automated student testing, and enhance instructor curriculum development and maintenance capabilities), desktop simulations, and electronic publishing and information retrieval systems.

Exportable Training Delivery Technologies

Existing classroom instruction methods are being scrutinized due to traveling costs and infrastructure operating costs (i.e., facility operating and maintenance costs). One option is to export training through distance learning methods and other remote delivery technologies. Distance learning is formal, institutionally based training and educational activities where the instructor and student are separated from one another in location. The primary objective of distance learning is to extend the learning environment to students at remote locations. New technologies have enabled more efficient training delivered at the job site that is embedded in or attached to operational equipment, and training delivered via Wide Area Networks (WAN) to locations distant from the instructor.

APPROPRIATE USES:
TRADAM is designed to assist training sponsors, training managers, course developers, and instructors in selecting appropriate advanced training technologies for the most cost-effective delivery of training. TRADAM is not designed to replace traditional training systems requirements analyses. The TRADAM process allows a quick assessment of the potential for resource savings through the implementation of appropriate advanced training delivery technologies in a given course.

EQUIPMENT REQUIRED:
- 486 or higher PC with 8 MB RAM
- Microsoft Windows Version 3.1 or Windows 95
- VGA or SVGA monitor capable of 256 colors
- Hard disc with 15 MB free disc space
- 3.5-inch floppy disc drive

INPUTS REQUIRED:
Phase 1: course length, equipment availability, travel requirement
Phase 2: learning requirements (team performance, interactions, equipment, imagery, interface)
Phase 3: personnel, travel, facilities, equipment

PROCESSING TECHNIQUES:

OUTPUT:
Phase 1: training environment (course compression, export)
Phase 2: candidate training technology (automated electronic classroom, video teletraining, network-based training, interactive courseware, embedded training, PC-based simulation, simulation/stimulation
Phase 3: costs, payback period, internal rate of return

USES OF OUTPUT:
For those courses where considerable savings potential is identified by TRADAM, a complete and thorough training systems requirements analysis should be performed prior to any course revision or procurement of training delivery hardware and software.

DOCUMENTATION:
TRADAM Version 2.1 User's Guide

ALTERNATIVE/COMPARABLE APPROACHES:

STAGE OF DEVELOPMENT:

COMMENTS:
The automated TRADAM Version 2.1 is available free to all U.S. Government employees. U>S> Government employees requesting access to the free download of TRADAM Version 2.1 should complete the TRADAM Software Request Form (http://ott.sc.ist.ucf.edu/refs/tradam.htm). All non-U.S. Government individuals interested in obtaining TRADAM should contact Renee Smith (rsmith@jht.com), Jardon and Howard Technologies, Inc.

For technical details about TRADAM, contact:
TRADAM Support
Phone: (407) 381-8688 / DSN 960-8688
FAX: (407) 381-4219 / DSN 960-4219
E-mail: TRADAM@ntsc.navy.mil

OVERALL CATEGORY: Analytic Technique
STATUS: Available

TITLE: Tribus Process Analysis

SPONSOR: Naval Air Warfare Center - Weapons Div (NAWCWPNS)
POINT OF CONTACT: Ms Gene Schneider / 619-939-9755, DSN: 437-9755
EMAIL: gene_schneider@MLNGW.chinalake.navy.mil
RECORD NO.: HSI00091

GENERAL OVERVIEW:
This method uses the Tribus "deployment" flowcharting technique to document work processes. The Tribus charts look a lot like software flowcharts, in terms of the symbology used. Certain aspects of the charts, however, make this method powerful for documenting processing:

1. There is a heading across the top of each chart that tells functional "agents" responsible for performing the activity implied by each symbol, and other agents who take part in or provide support for the activity.
2. Each chart is required to be only one page long, so everything you need to know to understand the chart is on that page.
3. Subprocesses within processes are designated by a special symbol that means there is another whole chart that gives details of the process underlying that task name.

The overall method encompasses processes of its own, involving:

1. Starting a task team to analyze and document processes.
2. Running and recording results of task team meetings.
3. Communicating progress to the task team.
4. Designing and developing the charts themselves.
5. Writing the background documentation for each chart.
6. Performing CM and change control on the charts.
7. Distributing new and updated charts.

APPROPRIATE USES:
The method can be used in any situation that requires documenting work processes. These charts are useful as "division markers" in Procedure Manuals. Generally, the charts stop at a level of detail just above that of step-by-step desk procedures.

EQUIPMENT REQUIRED:
This method does not really require use of computers. The current implementation runs on Macintosh. We use:

1. WORD for documents, team letters, etc.
2. MacDraw Pro for the final, distributable charts.
3. FileMaker Pro for the Process Change Request database.
4. QuickMail for distributing memos, etc., electronically.

PROCESSING TECHNIQUES:
None (...unless task team meetings are considered a Processing Technique).

OUTPUT:
A book containing: 1) process charts; 2) background information on how to read the charts; and 3) the Process Change Request form and instructions for its use. As they become available, it will also contain "MiniSpecs" describing each chart (its purpose, relationship to other charts, and a short definition of each activity/symbol).

USES OF OUTPUT:
The main use of the charts is to make sure everyone on a project team

understands: 1) what activities must be done during each project phase; 2) in what order things are done; 3) who is responsible for accomplishing each activity; and 4) what dependencies exist between activities and the agents who perform them. The charts are also used to design schedule and resource templates for project planning. To a lessor extent, they are used to track project progress.

In the future, more exacting use will be made of the chart: each activity, and each functional agent who works on it, will be assigned to a unique place in a MIL-STD Work Breakdown Structure (WBS); If this turns out to be effective, actual project costs can be linked to the WBS. This information can be used to improve project planning and estimating techniques, and to refine our understanding (and documentation) of the work processes themselves.

DOCUMENTATION:
[Tribus doc.]
"Putting TQM to Work," American Training Alliance, 1991.
Tribus Process Analysis Engineer's Handbook (draft), NAWCWPNS (C2103), China Lake, CA, February 94.

ALTERNATIVE/COMPARABLE APPROACHES:
Entity Relationship Diagrams
Control/Data Flow Diagrams

STAGE OF DEVELOPMENT:
The method is fully operational. Like all TQM methods, it is continuously being improved.

Copies of the Tribus Process Analysis Engineer's Handbook are available on request from the POC. Please contact, Ms. Eugenia Schneider, Code C2193, Naval Air Warfare Ctr - Weapons Div., China Lake, CA 93555-6001, telephone 619-939-9755 / DSN 437-9755.

COMMENTS:
We are experimenting with a tool, called TeamFlow, that task teams might use to draft new or updated charts. Using TeamFlow, we can ignore the one-page constraint, both on activities (vertical) and agents (horizontal), while we are brainstorming. It also gives us much more ability to move objects. TeamFlow also provides a structure for defining agents and their relationships, and the "MiniSpecs" for each symbol that appears on the chart. Unfortunately, it doesn't allow us to use all the Tribus symbols, but we can live with it.

In a few charts, it was necessary to show when things happen on an annual cycle, so we added a column down the side with dates in it.

OVERALL CATEGORY: Database
STATUS: Available

TITLE: Army Safety Management Information System (ASMIS)

SPONSOR: Army Safety Center
POINT OF CONTACT: Ms Jewnita Clark / 334-255-3889, DSN: 558-3889
EMAIL: clarkj@safety-emh1.army.mil
RECORD NO.: HSI00085

GENERAL OVERVIEW:
To do their jobs effectively, designers, trainers, researchers, safety engineers, and all others involved in MANPRINT/HSI activities must have direct knowledge of the problems that "users" have during the operational use of Army systems. This database provides such critical information on all Army systems (air and ground) to help define and prioritize warfighting issues/needs.

ASMIS contains many years of data on accidents reported by field units from all over the world. Safety regulations and accident directives are also accessible. Two examples of its capabilities are: 1) it can be queried to define accident populations/profiles by age, grade, MOS, height, weight, etc.; and 2) it can identify where the top problem areas are by dollar loss, fatalities, or frequencies of occurrence.

APPROPRIATE USES:
ASMIS provides support for DoD Human System Integration programs and Army MANPRINT programs during all phases of system development and operation. This includes defining issues, determining needs and priorities, and assessing system design to determine if identified issues were actually resolved, or if new human interface problems have arisen. Accident findings are in "field language", and must be translated into human performance issues.

EQUIPMENT REQUIRED:
ASMIS requires a personal computer with modem and a voice-grade telephone line.

INPUTS REQUIRED:
Follow user's guide to menus.

OUTPUT:
Information displayed on a computer screen, printouts, and "down load" data.

USES OF OUTPUT:
Output is used for definition and prioritization of critical human factors warfighting issues and needs. Users of this information include designers, trainers, researchers, safety professionals, manpower and personnel experts, and advanced technologists. MANPRINT Joint work groups, Science and Technology review boards, System Safety work groups, and Training and Simulation work groups are also users.

DOCUMENTATION:
ASMIS User's Manual

ALTERNATIVE/COMPARABLE APPROACHES:
Not applicable.

STAGE OF DEVELOPMENT:
ASMIS is fully operable, 24 hours per day. Accident "summaries' are available as part of standard information. Access to specific accident findings on human performance must be requested separately.

For more information about ASMIS, or for user identification and passwords, contact:

Ms. Jewnita Clark or LTC Nicholas
US Army Safety Center
ATTN: CSSC-S, Data Management
Bldg. 4905, 1209 5th Ave.
Ft. Rucker, AL 36362-5363

Phone: 334-255-3889 / DSN 558-3889

COMMENTS:
The information obtained is not releasable, except for purposes of government accident prevention. It may be used within DoD for safety purposes, and may not be used for any adverse administrative or disciplinary purposes (AR 385-40). The information may be released on a need-to-know basis only. It cannot be released without coordinating with the U.S. Army Safety Center.

OVERALL CATEGORY: Database
STATUS: Available

TITLE: Cost Avoidance Methodology

SPONSOR: Army Center for Health Promotion and Preventive Medicine (USACHPPM)
POINT OF CONTACT: MAJ W Michael McDevitt / 410-671-2925, DSN: 584-2925
EMAIL: wmcdevit@aehal.apgea.army.mil
RECORD NO.: HSI00158

GENERAL OVERVIEW:
Failure to eliminate or control health hazards can be costly to an organization. Uncontrolled exposures to health hazards may cause employee injury and illness. Health, Safety and Environmental staff professionals are more likely to obtain line management commitment to eliminate or reduce equipment or process hazards if they communicate both the health risk and associated health hazard costs. Managers who understand both health hazard costs and health risk are better equipped to make a decision on whether to eliminate or control a health hazard related to their equipment or process.

APPROPRIATE USES:
A methodology was developed to assist the U.S. Army estimate materiel system health hazard costs based on the probability of a hazard occurring and the severity of that hazard. Nine health hazard categories were crosswalked with potential medical outcomes. Incidence rates were researched and costs were calculated based on industry-wide injury, lost time, hospitalization and disability data. These costs were then related to the existing health risk indices. This information is used to provide a total cost related to hazards inherent in materiel systems. If abatement costs are provided, a cost effectiveness index (CEI) can be calculated. This should promote an increase in the reduction or elimination of health hazards.

EQUIPMENT REQUIRED:
Computer and Access software. Computer, as a minimum, should be a 486, with 16 megabytes of RAM and a 680-megabyte hard drive.

INPUTS REQUIRED:
Information needed to calculate the cost avoidance figures include: number of systems in the Army inventory; number of people involved in the use of each system; risk category (high, medium, low); inherent hazards and their Risk Assessment Code (RAC); and hazard abatement costs if a CEI is desired.

PROCESSING TECHNIQUES:
The above information is entered into a cost calculator, and then the developed methodology prompts the user to respond to various questions; after the questions are satisfactorily answered, the methodology calculates the cost avoided for a single year and for the 20-year life of the system if the recommendations are implemented.

OUTPUT:
A report is generated which lists the dollar amount applicablt to each specific hazard, and the number of exposures, injuries, and lost days involved with each hazard.

USES OF OUTPUT:
This information is essential for the materiel managers so that determinations can be made as to the priority and feasibility of implementing the recommendations suggested to avoid the hazards inherent in

a particular materiel system.

DOCUMENTATION:
User's guide is in development.

ALTERNATIVE/COMPARABLE APPROACHES:
Environmental, Safety, and Health Management and Cost Handbook

STAGE OF DEVELOPMENT:
First version

VALIDATION:
None

COMMENTS:

OVERALL CATEGORY: Database
STATUS: Available

TITLE: CSERIAC Anthropometric Data Analysis (CADA)

SPONSOR: CSERIAC Program Office
POINT OF CONTACT: Ms Rebecca A Unger / 937-255-5156, DSN: 785-5156
EMAIL: unger@cpo.al.wpafb.af.mil
RECORD NO.: HSI00179

GENERAL OVERVIEW:
In 1994, the Crew System Ergonomics Information Analysis Center (CSERIAC) acquired a large repository of traditional two-dimensional anthropometric data from the Computerized Anthropometric Research and Design (CARD) Laboratory of the Paul M. Fitts Human Engineering Division of the Armstrong Laboratory at Wright-Patterson AFB, OH. This repository of data originally consisted of over fifty U.S. and international anthropometric surveys on both military and civilian populations. These surveys represent more than forty-five years of research, and account for hundreds of measurements on thousands of individuals.

Since these surveys were conducted by many individuals and organizations over a long period of time, the measuring techniques and terminology were not always consistent from survey to survey. For example, "stomach depth" in one survey may have been termed "abdominal depth" in another, and waist circumference may have been measured at the level of the navel in one survey, and at the level of the subject's waist's natural indentation in the next survey. To eliminate these inconsistencies and the confusion they create, CSERIAC performed an exhaustive evaluation of all the surveys for which the documentation could be obtained, determined the similarities and differences between the surveys and the measurements, and developed a standardized coding scheme to be applied to the measurements across all of the surveys.

A total of 33 surveys have been evaluated and are now available for general use. Each survey contains the original ASCII dataset file and a text file that describes the survey, provides the documentation reference, and lists the specific variables that are included in the survey. The ASCII data can be directly imported into any statistical software package on a personal computer (PC) or Macintosh(t) computer for analysis.

A manual is also provided which contains the standardized measurement definitions, a glossary of landmark definitions, a complete list of the standardized measurements and their codes, and the information needed to order the documentation for the surveys.

APPROPRIATE USES:
This tool is applicable for use in designing any system in which a human interacts. For example, workspace design, computer-aided design (CAD) man models, furniture design, and tool design.

EQUIPMENT REQUIRED:
Personal computer and a statistical analysis software package: Windows 95, 486 processor or better, 16 MB RAM, 1MB hard drive; user-provided PC statistical package, such as SAS, SPSS, Statistica, etc.

INPUTS REQUIRED:
A computer file disc is furnished with the package. This disc contains a data file with the raw data and a text file containing background

information on the survey and a list of the variables.

PROCESSING TECHNIQUES:
The analyst using this data should have an understanding of human factors engineering, anthropometry, and statistical analysis. The analyst needs to select the appropriate body dimensions needed for the design and conduct of a statistical analysis on these dimensions. These results are then summarized and applied to the system design.

OUTPUT:
Data analysis results printout provided by the statistical package.

USES OF OUTPUT:
This data can be used for comparison of actual vs. needed design body dimensions.

DOCUMENTATION:
Manual provided.

Unger, Rebecca A. (1996), The CSERIAC Anthropometric Data Files, Gateway, Vol. VII (2), p. 7, CSERIAC, Wright-Patterson AFB, OH.

ALTERNATIVE/COMPARABLE APPROACHES:
Computerized Anthropometric Research and Design (CARD) Lab 3-D data.

STAGE OF DEVELOPMENT:
Ready for distribution.

COMMENTS:
Costs: 1-5 surveys, $100 each; 6-10 surveys, $80 each; 11-15 surveys, $64 each; 16-30 Surveys, $50 each; total package, $1,500.

OVERALL CATEGORY: Database
STATUS: Available

TITLE: Defense Instructional Technology Information System (DITIS)

SPONSOR: Defense Manpower Data Center
POINT OF CONTACT: Ms Dana M Freeman / 408-583-2400, DSN: 878-2951
EMAIL: DITIS@osd.pentagon.mil
RECORD NO.: HSI00176

GENERAL OVERVIEW:
Instructional developers, trainers, planners, and policy makers are faced with decisions which impact both the quality and cost of Department of Defense (DoD) training. Many of these decisions involve the use of instructional technology. The types of issues these users must address include: development of cost-effective training for new weapon systems, identification of training that can be brought to the field or local site, managing within budgeted training funds, and revising training pipelines to meet operational requirements. The overall objective of the DITIS program is to improve the ability of training managers to quickly address these and related issues, thereby improving the quality of training while concomitantly reducing costs.

The primary purpose of DITIS is to facilitate the sharing of Interactive Courseware (ICW) resources within the DoD. From the field perspective, DITIS will serve as the user interface to access and update ICW data, and satisfy the requirements of the DoD Directive (DODI 1322.20) regarding management and development of ICW. To accomplish this, a DITIS database, consisting of relevant information about currently fielded and developmental ICW training programs, was developed. This central source of information is designed to give ICW planners and developers a means of more efficiently using existing DoD ICW resources to meet training requirements.

APPROPRIATE USES:
The DITIS database is accessed by the training user in the field at several times in the life cycle of an ICW program. These interactions occur specifically during the following:

Initial Query -- By DoD directive, the DITIS database must be queried to determine what existing ICW programs meet, or can be cost-effectively modified to meet the user's training requirement.

Proposed Development -- As part of the requirements definition process, but before the decision to develop or fund an ICW program, general information about the proposed ICW program is entered into the system.

Under Development -- Within 30 days following component approval to develop or fund the ICW program procurement, the originating activity enters updated program information describing the ICW program into the system.

Development or Acquisition Completion -- Within 30 days following completion of ICW program development or acquisition, the DITIS record for the program is updated to reflect the final program characteristics (including software and hardware requirements), and other management information.

Program Revision -- The DITIS record is updated to reflect any major changes or additional data regarding the ICW program, such as modification, addition, or deletion of a module or lesson, within 30 days of any such revision or new data.

Program Termination -- The DITIS record is updated to indicate program termination, removal from service, or similar change in status within 30 days of any such change.

EQUIPMENT REQUIRED:
IBM-compatible microcomputer 386 or higher, 3.5 floppy disc drive, VGA or higher graphics display, 4MB memory (8MB preferred), Windows 3.1 or later (including Windows 95), running in enhanced mode, 9600 baud or higher modem (or direct access to the Defense Information Systems Network (DISN).

INPUTS REQUIRED:
DITIS provides input screens based on DD Form 2568 to enter/update the individual ICW records. Searching DITIS is done by entering subject keywords.

OUTPUT:
Screen display of individual ICW record data, which can also be printed; information includes ICW description, uses, owner organization, and POC.

USES OF OUTPUT:
User can determine if there is an already existing course, or one in development, that can be used or modified to suit their needs, thereby saving time and money. Sponsoring organization information is provided so that the courseware can be acquired for use.

DOCUMENTATION:
DITIS for Windows 2.0 User Guide is available online, or contact the DITIS Database Coordinator to receive a copy by mail.

ALTERNATIVE/COMPARABLE APPROACHES:

STAGE OF DEVELOPMENT:
Operational, and in constant revision with new and updated ICW records. The DITIS Website URL will change in Summer, 1998. Also, Web-based queries will be available. Cotact the DITIS Coordinator for updated information.

COMMENTS:
Any questions regarding the DITIS-DAVIS merge may be addressed to:
Richard Latson, 703-428-0640 / DSN 328-0640, rclatso@hq.afis.osd.mil.

Individuals/organizations interested in obtaining access to DITIS should complete and submit an online application form, and/or contact the POC listed above, to establish an account. Once you have been contacted by the DITIS Database Coordinator with your DITIS account information, you can download the DITIS for Windows client software from online.

OVERALL CATEGORY: Database
STATUS: Available

TITLE: Defense Manpower Data Center (DMDC)

SPONSOR: Department of Defense
POINT OF CONTACT: Mr Michael A Dove / 408-583-2400, DSN: 878-2951
RECORD NO.: HSI00100

GENERAL OVERVIEW:
DMDC is the most comprehensive repository of personnel, manpower, training and financial data in the DOD. Our data and programs encompass the military personnel life cycle from accession to retirement, reserve components, families and dependents of Service Members, and civilian employees of the DOD. To facilitate the speed and accuracy of responding to data requests, DMDC maintains the data in a variety of media: files, data delivery systems, and published reports. DMDC also manages several operational programs using these databases. Automated Personnel data extends back in time to the early 1970s, while the other categories of data represent significant holdings, and in most cases provide the only single source of commonly coded data on the Military Services.

APPROPRIATE USES:
DMDC's primary function is to support the management information requirements of the Office of the Under Secretary of Defense for Personnel and Readiness (OUSD/P&R). We also provide data and analysis for other OSD offices, agencies, and individuals outside the DOD.

EQUlPMENT REQUIRED:
Some of our data delivery systems (Defense Instructional Technology Information System, and the Standard Installation Topic Exchange Service) require additional equipment, such as a modem, a CD player, and certain versions of software. Equipment requirement questions are best answered by the system's point of contact at DMDC.

INPUTS REQUIRED:
DMDC has a standard operating procedure, depending upon the agency, to handle data requests. Some of DMDC's data is subject to the Privacy Act of 1974. DMDC ensures that the data is used in compliance with privacy act requirements and that adequate protection is taken for its safeguard. Every file, program, delivery system, and published report has a point of contact at DMDC who can guide you through the request process. Most of our services are free of charge; however, some Freedom of Information Act requests do involve a fee.

PROCESSING TECHNlQUES:
Our data resides primarily on a mainframe maintained at the Naval Postgraduate School in Monterey, CA. We use a combination of packaged (PLI, COBOL, SAS, SYNCSORT) and in-house developed programs to manipulate the data files on the mainframe. Depending upon the anticipated use of the data, output from the mainframe may be downloaded to the level of a personal computer for further analysis and cleaning. DMDC's Information Delivery System provides personal computer desktop information to the user via the World Wide Web, and can be downloaded in a spreadsheet environment.

OUTPUT:
Output can be delivered in almost any way that is most convenient for the customer. Traditionally, output has been generated as spreadsheets, reports, graphs, and frequency distributions. The output can be downloaded to discs,

tapes, reels, and CDs. Sometimes the output is printed, and then mailed or faxed to the customer; sometimes the data is sent ftp/electronically. DMDC has also developed data delivery systems that, through a graphical user interface, report the data on user-friendly PC screens.

USES OF OUTPUT:
Use of the output varies as widely as our means of delivering it. Our customers, outside of the OUSD (P&R), include Congressional offices, the Office of Management and Budget, the Defense Finance and Accounting Service, the General Accounting Office, Office of Personnel Management, all military components, the Per Diem Travel and Transportation Allowance Committee, and various government contractors using the data for analysis. Among the many ways our data has been used operationally is in identification of delinquent debtors on Government Loan programs, setting active duty housing and living allowances, analyzing troop readiness, and in contributing to reports studying historical trends in the military.

DOCUMENTATION:
1998 DMDC Profile: This book lists and describes the files, operational programs, data delivery systems, and published reports available to our customers. It also provides a glimpse at six projected programs underway. Points of contact are listed with more detailed descriptions about how to use DMDC. This document will be available at DMDC's Website in April of 1998.

ALTERNATIVE/COMPARABLE APPROACHES:
DMDC is widely recognized as the only source of automated DOD personnel data that crosses Services and type of DOD employment, and that can provide data in a quick response mode to those doing analysis of the DOD workforce.

STAGE OF DEVELOPMENT:
As a growing and dynamic organization, DMDC has developed new projects to meet the needs of our customers. Many of the current projects in development are using the latest computer and communications systems, such as laptop computers, PC software, multi-media technology, and the Word Wide Web.

COMMENTS:
None.

OVERALL CATEGORY: Database
STATUS: Available

TITLE: Defense Technical Information Center (DTIC)

SPONSOR: Defense Technical Information Center (DTIC)
POINT OF CONTACT: Ms Julie M Foscue / 800-225-3842, DSN: 427-8273
EMAIL: Website: http://www.dtic.mil/
RECORD NO.: HSI00175

GENERAL OVERVIEW:
As a component within the Defense Information Systems Agency (DISA), the Defense Technical Information Center (DTIC) provides support for the nation's warfighters by facilitating information exchange throughout the Defense establishment. For over 50 years, DTIC has been the central repository of defense-related information within the Department of Defense (DoD). DTIC acquires, analyzes, stores, and disseminates scientific and technical information to support the management and conduct of DoD research, development, acquisition, engineering, and studies programs.

The majority of DTIC's holdings are unclassified; however, the collection does include limited and classified information through the Secret level.

DTIC's collection contains reports and management information generated by scientists, engineers, economists, students, professors, program managers, and others within U.S. and foreign government, industrial, and academic organizations. The holdings include technical reports, management summaries at the work unit level, independent research and development summaries, and special collections, such as captured German and Japanese documents that date back to World War II. The collection encompasses all DoD-relevant technology areas, which includes the technologies covered in the Directory of Design Support Methods (DDSM).

APPROPRIATE USES:
U.S. Government organizations and their contractors, subcontractors, grantees, and potential contractors are eligible to receive information from DTIC. Users of DTIC's products and services enhance their research by reviewing, on a recurring basis, the material in DTIC's databases that is pertinent to their projects. Using DTIC's information products, instead of searching for appropriate material from many separate sources, saves both time and effort.

EQUIPMENT REQUIRED:

INPUTS REQUIRED:
Services are available to organizations that are eligible to receive DTIC services, and that are registered DTIC users. To request a registration packet, contact DTIC's Registration Branch: 800-225-3842; e-mail, reghelp@dtic.mil. Services are provided via direct request to a DTIC regional office, online access, or products such as CD-ROM format databases.

In addition, unclassified/unlimited reports are available through DTIC's STINET service: URL http://www.dtic.mil/stinet/.

PROCESSING TECHNIQUES:

OUTPUT:
DTIC accepts and disseminates information in paper, microfiche, nonprint, and electronic formats.

USES OF OUTPUT:
(See APPROPRIATE USES)

DOCUMENTATION:
Brochures: "DTIC at a Glance; "DTIC 1997-1998 Products and Services Catalog"; Website: http://www.dtic.mil/.

ALTERNATIVE/COMPARABLE APPROACHES:
DTIC is the comprehensive collection of DoD research-related documents. DTIC sends to the National Technical Information Service (NTIS) copies of technical reports which have a security classification specified by the contributors of "unclassified/unlimited", and which are, therefore, available to the general public.

STAGE OF DEVELOPMENT:
DTIC's databases are mature, and are updated on an ongoing basis. New products are periodically offered, as well as additions of information to the DTIC Website.

COMMENTS:

OVERALL CATEGORY: Database
STATUS: Available

TITLE: Design Traceability Manager (DTM)

SPONSOR: Air Force Research Laboratory
POINT OF CONTACT: Mr Dave G Hoagland / 937-255-4046, DSN: 785-7593
EMAIL: dhoagland@falcon.al.wpafb.af.mil
RECORD NO.: HSI00182

GENERAL OVERVIEW:
The complexity of modern aircraft continues to challenge today's crew-system design teams. Past practice results include:
- late discovery of operator-related design flaws;
- expensive re-design;
- additional training burden; or
- a combination of these --

the consequences being degraded operability and increased cost.

These pervasive problems can be minimized by following a tailorable, structured process with traceability of design decisions. A new Crew-centered System Design Process, or CSDP, is now available to capture design traceability. To make the CSDP efficient, an entirely new, PC-based computer tool was constructed, called the Design Traceability Manager, or DTM. DTM's objectives are to provide the crew system design team with three useful and practical capabilities:
- Assistance in managing each crew system design project, with tools for planning and tracking progress;
- Ability to inspect the CSDP online, and guide the resulting crew system design integration;
- Ability to capture the traceability of the evolving design, and track the rationale for crew system engineering decisions.

APPROPRIATE USES:
DTM should be used to support Project Planning, Project Management, and Project Implementation during crew system design activities of the Weapon System Acquisition Process. DTM is also flexible enough to support these same project activities for a customized design process. DTM allows for the creation, management and implementation of the user's own process. Through the use of DTM, the user is offered:
- Online access to the CSDP or custom-developed process, readily tailorable information on demand;
- Enhanced project planning and management (scheduling, monitoring, reporting)
- Data creation and flow, facilitating reusability of data, traceability of design decisions, and project team communication, compatible with the integrated product team (IPT) philosophy;
- PC-hosted flexibility, providing greater availability to the full design team through affordable workstations;
- Connectivity to leading commercial-off-the-shelf (COTS) packages (Microsoft);
- WATCOM as the database management system, distributable free-of-charge to Government contracts;
- Windowed interface, providing improved usability and greater familiarity.

EQUIPMENT REQUIRED:
PC-DOS or MS-DOS operating system, Version 3.3 or above; Intel 486/66 processor or higher; minimum 16 MB RAM; 30 MB hard drive; MS Windows 3.1,

Windows NT 3.5; 3.5" high-density disc drive.

INPUTS REQUIRED:
The data is hand-entered by the user, capturing the scheduling, day-to-day logbook of crew system design activity, and/or traceability information relevant to the products created through the implementation of each process activity. It is recommended that the user implement the logbook feature of DTM for capturing day-to-day information about activities or analyses performed for a given crew system design activity. Once an activity has been completed, and a product or output produced, the user documents a crew system traceability report about the given product. The MS Word software is recommended for documenting textual information to make full use of the word processing capabilities. This information can either be copied and pasted directly into the relevant DTM data fields, or the entire document can be copied into the DTM document feature.

PROCESSING TECHNIQUES:
There is no pre-analysis data reduction and preprocessing for this tool. However, the user does need to review the CSDP and tailor (select) the activities relevant for a given crew system design project. For each of the classical weapon system design and acquistion phases -- Concept Exploration (CE), Program Definition and Risk Reduction (PDRR), and Engineering, Manufacturing, and Development (EMD) -- DTM users can access and invoke the CSDP activities. The activities are grouped into four categories:

- Program Planning
- Requirements Analysis and Predesign
- Design
- Evaluation

The DTM provides direct access to the details within the crew-centered process, providing support for performing analysis and design work, while helping to understand the workflow. Users can navigate the CSDP for guidance in the form of Activity Information Pages (AIP). AIPs provide guidance for performing technical tasks, including suggestions for when each activity should be performed, suggested procedures, tools, lessons learned, expert advice, and templates.

After users have completed crew system design activities, documented a crew system traceability report (CSTR) about the output or product created, and updated the project schedule, the user can start to compile CSTRs to create final deliverable documentation.

OUTPUT:
The final products from the use of this tool include:

- Project Schedules
- Traceability Reports
- Project Deliverables, such as Crew System Program Plans, Analysis Results and Recommendations, Crew System Specifications, Part-Task Simulation Test Plans, Simulation Results, and Project Final Reports or Deliverables.

These deliverables are easy to produce through the compilation of Logbooks and Crew System Traceability Reports. The user may also compile information through keyword or crew system component searches of the database. The rationale for crew system design decisions and final crew system design recommendations and specifications can be traced through the process used and the design decision rationale documented within the CSTRs.

USES OF OUTPUT:
This tool was specifically designed to support the United States Air Force

Weapon Acquisition Process in the development of justifiable crew system designs. In that light, the products that are created are crew system design deliverables to the USAF. These deliverables can take many forms, and are project-dependent. The primary benefits of using DTM for the development of products are the ease with which the products are created, and the ability to trace design solutions to their analytic source.

Analyst qualifications: B.S. in Hun Factors; 2-5 yrs. HFE crew system design experience; 4 hrs. training on tool.

DOCUMENTATION:
Veda, Inc. (1997), "Crew-Centered Design Technology (CCDT) Program Design Traceability Manager (DTM) User's Manual", Document No. 63033-97U/P60099, Contract No. F33615-92-C-5936, Armstrong Laboratory, Air Force Materiel Command (Human Systems Center), Wright-Patterson AFB, OH 45433, Dayton, OH: Veda, Inc.

ALTERNATIVE/COMPARABLE APPROACHES:
None.

STAGE OF DEVELOPMENT:
Latest version is 2.2; no planned upgrades; software available through POCs.

VALIDATION:
DTM was verified through its application and upgrade in four Field Demonstrations (example, crew system design-type problems). Three final reports were documented, and are available through the POCs.

COMMENTS:
Alternate POC: Ms. Cindy D. Martin, 5200 Springfield Pike, Ste. 200, Dayton, OH 45431-1289, 937-476-8849/DSN 785-8849/FAX 937-476-2900, E-mail: cmartin@dytn.veridian.com, Website: www.veridian.com.

OVERALL CATEGORY: Database
STATUS: Available

TITLE: Master Acquisition Planning Program (MAPP)

SPONSOR: Naval Sea Systems Command
POINT OF CONTACT: Ms Sally Pritsch / 703-602-9177, DSN: 332-9177
EMAIL: pritsch_sally@hq.navsea.navy.mil
RECORD NO.: HSI00141

GENERAL OVERVIEW:
MAPP is a Government Off-The-Shelf (GOTS) software product which serves as a database repository for program planning data. Traditionally, this data is developed and maintained in a myriad of separate documents and databases. Initiating and maintaining these various data sources is labor-intensive and leads to both redundancy and inconsistency, as well as attendant expenditure to develop, maintain, and correct this data. The MAPP is an established DoN acquisition reform initiative designed to eliminate duplicative data, reduce cost, ensure that data requirements reflect program office needs, and provide current, accurate information to decision makers. The MAPP integrates data required by the various disciplines and activities involved in the acquisition process. It supports the Integrated Product Team (IPT) concept: all program management information is resident in a single database, enabling all program participants to share the same data. The MAPP eliminates the redundancy inherent in the program documentation process by allowing users to enter data one time and use it to support all management and oversight requirements. As a result, fewer resources -- in terms of both dollars and manpower -- are required, the quality of data is improved, and inconsistencies are eliminated. The MAPP is tailorable to the acquisition category and phase of the given acquisition program. MAPP is currently being used throughout the Navy to define, direct, document, and monitor program decisions.

Since the acquisition program planning requirements of the MAPP are based upon the DoD 5000 Series documentation, all DoD organizations (and many non-DoD Government agencies involved with acquisition programs) can use the MAPP. The Army, Air Force, and Coast Guard have expressed interest in using MAPP; and it has been provided to the FAA for use, and to the SBA for evaluation (at their request). From the interest generated from Government activities outside the Navy, it is clear that the MAPP has great potential to become a resource which can be used by all of the DoD Services. The evolution of the MAPP is certainly pointed in that direction.

The MAPP application includes over 190 database tables encompassing approximately 1,000 data fields. The application is structured so that data is maintained separately from the application objects. This architecture will allow easy upgrade of the application as new features are developed. Financial data is handled through the use of embedded Excel spreadsheets. Object Linking and Embedding (OLE) technology is also used to store figures (diagrams, Word tables, video, etc.) in the database. Any Windows-based graphics software that supports OLE can be used to generate and maintain figures in the MAPP database.

EQUIPMENT REQUIRED:
IBM-compatible PC with, at minimum, a 486DX/66 processor, 16 MB RAM, SVGA monitor (800x600 resolution); Windows 3.1; DOS 6.2; Microsoft Word and Excel. The application requires a minimum of 20 MB hard disc space.

INPUTS REQUIRED:

MAPP presents the user with baseline data requirements (i.e., program planning data that should be documented as the acquisition progresses). An extensive HELP system provides the user with guidance for completing each data requirement; data requirements may be tailored-out or tailored-in as required to document the requirements and plans of the acquisition program. MAPP allows program offices to limit access rights to data tagged by the program office (i.e., read-only access rights).

OUTPUT:
Specialized output reports include an Acquisition Plan (AP), Operational Requirements Document (ORD), Test and Evaluation Master Plan (TEMP), Computer Resources Life Cycle Management Plan (CRLCMP), Navy Training Plan (NTP), and User's Logistic Support Summary (ULSS). Special output reports are generated as Microsoft Word 6.0 documents, and emulate the format of traditional acquisition documentation.

USES OF OUTPUT:
MAPP Release 1.1 provides a number of preformatted output reports to support oversight and milestone decisions.

DOCUMENTATION:
MAPP User Handbook and MAPP Performance Specification

ALTERNATIVE/COMPARABLE APPROACHES:

STAGE OF DEVELOPMENT:
MAPP Ver 1.1 is fully operational and available.

COMMENTS:

OVERALL CATEGORY: Database
STATUS: Available

TITLE: Requirements Analysis Tool (RAT)

SPONSOR: Naval Air Warfare Center - Weapons Div (NAWCWPNS)
POINT OF CONTACT: Ms Gene Schneider / 619-939-9755, DSN: 437-9755
EMAIL: gene_schneider@MLNGW.chinalake.navy.mil
RECORD NO.: HSI00092

GENERAL OVERVIEW:
RAT is a database structure used to document and track evolution of system or project requirements. The information in RAT includes:

1. Requirement Identification (based on a system/project Functional Hierarchy).
2. Requirement Definition (including name, description, implementation, and comments).
3. Requirement Source(s).
4. Requirement Testing Data.
5. Database Configuration Management Data.

APPROPRIATE USES:
The main purpose of RAT is to provide requirement traceability throughout the lifecycle of a project; specifically, RAT is used to generate traceability tables for project projects. Other uses to which various versions of RAT have been put include:

1. Presentation slides for Requirements Reviews.
2. Tables of contents for documents and presentation slides.
3. Main body text of certain requirements documents.
4. Audit tables for evaluating test and document completeness.
5. Documentation of requirement allocation to test modes, "media" (hardware, software, and liveware), and subsystems.

EQUIPMENT REQUIRED:
The current implementation is in Claris Filemaker Pro, which works on both Macintosh and PC (Windows or DOS) computers. But the RAT "method" is generic, not limited to particular equipment or software.

INPUTS REQUIRED:
The main inputs are system/project requirements, in any form in which they may exist. The person who enters the requirements into RAT must do minor editing to determine which parts of the requirement are to be used for the description, implementation, and comments part of the database record, and what to use for the requirement "name" (which begins with a verb from a standard list).

Other inputs are:

1. Functional Hierarchy identifier (from a separate database).
2. Analysis data on types of testing to be performed.
3. Analysis data on allocation of requirements to subsystems.

The Requirement Identifier, made up of the Functional Hierarchy identifier and a "sequence number," is required. The other inputs are optional for the main purpose of RAT, but required for secondary uses.

PROCESSING TECHNIQUES:
The person entering data into RAT must categorize the information in the source documents as being part of the name, description, implementation, or comments about the requirement. In many cases, this person must also analyze

where one requirement ends and another begins, based on knowledge of the system or project.

Before the RAT data can be used in reports, someone must assign unique identifiers to each requirement. This requires assigning each requirement to a place in the Functional Hierarchy, and adding a "sequence number" to distinguish this requirement from others linked to the same Hierarchy item. (The "sequence number" may have its own hierarchical structure, effectively taking the hierarchy to lower levels of detail, or may just be a number.)

OUTPUT:

1. Traceability tables for use in system/project documents.
2. Presentation slides for Requirements Reviews.
3. Tables of contents for documents and presentation slides.
4. Main body text of certain requirements documents.
5. Audit tables for evaluating test and document completeness.

DOCUMENTATION:

RAT Data Book...available from the POC. (See comment in "Stage of Development.)

ALTERNATIVE/COMPARABLE APPROACHES:

There are several commercial products that attempt to provide documentation and traceability of requirements. The two best ones are:

1. RDD - [Unix] total system model; not enough info on requirements.
2. RTM - [DOS] too constrained: report formats, field sizes and types, etc.

STAGE OF DEVELOPMENT:

RAT (and FHier, the Functional Hierarchy database) have been in use by various Navy avionics projects for almost 10 years. So the method itself is robust. Unfortunately, however, there has never been time to document the databases and their usage procedures formally, so documentation is mostly in the form of presentation slides.

The two database formats (RAT and FHier) and associated documentation (in Microsoft WORD) are available on Macintosh disc from the POC. Please contact: Ms. Eugenia Schneider, Code C2193, Naval Air Warfare Ctr - Weapons Div., China Lake, CA 93555-6001, phone 619-939-9755 / DSN 437-9755.

COMMENTS:

Effective use of RAT assumes the existence of a Functional Hierarchy, in which is exactly and the only one place to assign each system or project requirement. Creating such a hierarchy is difficult.

We have investigated each commercial "Requirements Management System" as it becomes available, and have not found any that meet our needs. The fatal flaw in most of them is assuming that you START WITH a viable requirements document, the table of contents of which is a meaningful "Functional Hierarchy." In our environment, we need RAT to gather requirements from man sources, design a meaningful Functional Hierarchy to attach them to, and then GENERATE a viable requirements document.

OVERALL CATEGORY: Handbook/Guide/Course
STATUS: Available

TITLE: Air Force Systems Command Design Handbooks

SPONSOR: Aeronautical Systems Center
POINT OF CONTACT: Ms Dorothy Cauley / 937-255-6281, DSN: 785-6281
EMAIL: cauleydj@asc-en.wpafb.af.mil
RECORD NO.: HSI00056

GENERAL OVERVIEW:
The Design Handbooks are specialized publications which provide an authoritative source of design data in support of the definition, design, and development of Air Force systems and equipment. There are currently 19 handbooks. DH 1-3, Human Factors Engineering is one handbook within the General Design Criteria series. The second series contains handbooks for Aeronautical Systems design criteria.

APPROPRIATE USES:
The Handbooks are used in applying technical knowledge to Air Force system and equipment acquisition programs. They are intended to convey proven techniques and to prevent repetition of past research and development errors.

OUTPUT:
Provides design data, technical knowledge, and proven techniques easily available for use in Air Force acquisition programs.

USES OF OUTPUT:
Acquisition programs; designing of Air Force systems.

DOCUMENTATION:
Not applicable.

ALTERNATIVE/COMPARABLE APPROACHES:
Mil-Prime documents.

STAGE OF DEVELOPMENT:
The Handbooks are fully mature and have been widely used.

COMMENTS:
The distribution of Design Handbooks is limited to DoD employees and to those on the Defense Logistics Services Center's list of certified DoD contractors. Contractors who wish to become certified must fill out and submit to DLSC a Form DD 2345.

To order Design Handbooks, contact Dorothy Cauley, ASC/ENSI, 2530 Loop Row, Bldg. 560, Wright-Patterson AFB, OH 45433-7101, DSN 785-6281, commercial 937-255-6281.

OVERALL CATEGORY: Handbook/Guide/Course
STATUS: Available

TITLE: Embedded Training (ET) Guidelines and Procedures

SPONSOR: Army Research Institute (PERI-IK)
POINT OF CONTACT: Ms Dorothy L Finley / 502-624-2613, DSN: 464-2613
RECORD NO.: HSI00059

GENERAL OVERVIEW:
These handbooks provide the procedures and guidelines for selecting and developing Embedded Training (ET). They also provide source materials which provide information and examples of ET development documentation. The guidelines and procedures are based on experience with Army systems (FOG-M, HIP, SGT York, MCS-2, ASAS, FAADS, NLOS, ASM).

APPROPRIATE USES:
The handbooks are appropriate for those with responsibilities for training development and for the MANPRINT domain of training in all stages of the development cycle and for all milestones. Embedded Training is a mandated part of training development for any new systems or systems undergoing modification, MANPRINT, and the Integrated Logistics Support program.

EQUIPMENT REQUIRED:
No equipment per se is necessary to implement ET development methods; however, a database management system for manipulating task data would be of considerable assistance.

INPUTS REQUIRED:
The inputs necessary for this method include all available information on the missions and tasks to be performed, the soldier-machine interface, the computer subsystem architecture and software, and similar information on comparable systems.

PROCESSING TECHNIQUES:
The processing techniques used on the input data vary as a function of the objective to be achieved. The technique for each objective is specified in the guideline and procedures volume pertaining to that objective.

OUTPUT:
The output consists of an analytic basis for decisions regarding the feasibility of incorporating ET into the system to accomplish what training objectives; and, if feasible and of value, how ET is to be integrated into the system. Other outputs include guidance for test plans, design of the supporting logistics system, and inputs to system acquisition documents (e.g., requirements documents, statements of work).

USES OF OUTPUT:
The initial output is used in identifying the need for ET. Once the need is identified, then subsequent outputs can be used for specifying, designing, developing, and testing the ET and related support systems. The ET handbooks apply to relevant events and products produced by training developers, combat developers, testers, and contractors.

DOCUMENTATION:
Volume 1 has an extensive list of ET references.

ALTERNATIVE/COMPARABLE APPROACHES:
There are no other published approaches on ET design. The publication

Training and Doctrine Command (TRADOC) Systems Approach to Training (TRADOC Reg 351-7), addresses development of general training strategies.

STAGE OF DEVELOPMENT:
This ET methods development program has been completed. Ten volumes of guidelines and procedures, plus two additional reports extending Volumes 3 and 5, are available through Defense Technical Information Center (DTIC). To order from DTIC, write: Defense Technical Information Center, Reference and Retrieval Division, ATTN: DTIC-BR, 8725 John J. Kingman Rd., Ste. 0944, Ft. Belvoir, VA 22060-6218. Phone: (703) 767-8274 / DSN 427-8274.

Each of the ten volumes has, as the first part of the title, "Implementing Embedded Training (ET):...". Following are the document subtitles and the corresponding DTIC accession numbers:

Vol. 1- "Overview," AD A201 401
Vol. 2- "ET as a System Alternative," AD A2 04 836
Vol. 3- "Roles of ET in the Training System Concept," AD A201 427
Vol. 4- "Identifying the ET Requirements," Revised, AD A205 752
Vol. 5- "Designing the ET Component," Revised, AD A205 697
Vol. 6- "Integrating ET with the System," AD A207 982
Vol. 7- "ET Test and Evaluation," AD A207 290
Vol. 8- "Incorporating ET into Army Unit Training," AD A207 509
Vol. 9- "Logistics Implications," AD A206 794
Vol.10- "Integrating ET into Acquisition Documentation," AD A207 240

The additional reports are: "A Guide for Early Embedded Training Decisions," AD A239 669; and "A Guide for Early Embedded Training Decisions, Second Edition," AD A315 823.

Requests for DTIC AD numbers on other ET documentation or additional information should be addressed to either Army Research Institute, Attn: PERI-IK (Ms. Finley), Ft. Knox, KY 40121-5620, DSN 464-2613, (502) 624-2613; or Army Research Institute, Attn: PERI-IF (Dr. Witmer), 12350 Research Pkwy.,Orlando, FL 32826-3276, DSN: 970-3995, (407) 384-3995

COMMENTS:
All major requirements documents must include provisions for possible ET. Otherwise, preliminary designs may lack the computer, control, and display capacity and flexibility to permit later insertion of ET.

OVERALL CATEGORY: Handbook/Guide/Course
STATUS: Available

TITLE: Engineering Data Compendium: Human Perception and Performance

SPONSOR: Air Force Research Laboratory
POINT OF CONTACT: Mr Jeff Landis / 937-255-4099, DSN: 785-4099
EMAIL: landis@cpo.al.wpafb.af.mil
RECORD NO.: HSI00060

GENERAL OVERVIEW:
A landmark human engineering reference for system design, the three volumes have 2,758 pages with approximately 2,000 figures and tables. There also is a User's Guide which is bound in a swing hinge binder. The Compendium contains twelve chapters which include: Information Acquisition, Spatial Awareness, Perceptual Organization, Attention, Resource Allocation, Language Processing, Motor Control, Environmental Stressors, and Display and Control Interfaces.

APPROPRIATE USES:
The Guide is a reference for principles, mathematical functions, graphical representations, and design criteria relevant to human engineering for system design.

INPUTS REQUIRED:
Users with formulated system design problems can consult the Compendium for relevant human engineering data, theory, and methods that can be used for solution of the problem. Users can select among several structured approaches for accessing information depending on how well the design issue has been defined. Each major topical section contains a tab-locatable table of contents, glossary, and knowledge map providing a relational hierarchy of subtopics covered.

OUTPUT:
The Compendium gives data, methods, and theories relevant to the solution of design problems. The information is segmented into concise two-page entries addressing relatively narrow topics. The goal is to provide information in discrete units easily understood by a user with little experience in the topic area.

USES OF OUTPUT:
The Compendium incorporates and integrates large masses of information and provides easy access to human performances data and engineering principles for use in the system design process.

DOCUMENTATION:
Boff, K.R., Kaufman, L., Thomas, J.P. (Eds.), Handbook of Perception and Human Performance, John Wiley & Sons, NY, 1988.

ALTERNATIVE/COMPARABLE APPROACHES:
None.

STAGE OF DEVELOPMENT:
The Compendium is currently available from CSERIAC for a cost-recovery fee. For more information, or to order, contact:

Mail: AFRL/HEC/CSERIAC
Bldg. 196, Rm. 8
ATTN: Products & Services

2261 Monahan Way
Wright-Patterson AFB, OH 45433-7022

Phone: 937-255-4842 / DSN 785-4842
Fax: 937-255-4823 / DSN 785-4823

COMMENTS:
The 4 volumes cost $295.00 per set. There is an additional charge for shipping. The set consists of 3 data volumes and a User's Guide.

OVERALL CATEGORY: Handbook/Guide/Course
STATUS: Available

TITLE: A Handbook for MANPRINT in Acquisition

SPONSOR: Army Deputy Chief of Staff for Personnel (DCSPER)
POINT OF CONTACT: Ms Peggy Simmons / 703-695-7035, DSN: 225-7035
EMAIL: simmons@hqda.army.mil
RECORD NO.: HSI00190

GENERAL OVERVIEW:
The Manpower and Personnel Integration (MANPRINT) program was initiated to influence materiel system design by considering soldier capabilities and limitations as integral elements of total system performance. This is achieved by the continuous integration of seven human-related considerations: personnel capabilities, manpower, training, human factors engineering, system safety, health hazards, and soldier survivability.

The Handbook provides information on MANPRINT in general, the acquisition life cycle, the System MANPRINT Management Plan (SMMP), and the missions and composition of MANPRINT Working Integrated Concept Teams (ICT)/Integrated Product Teams (IPT). It also provides detailed advice on the activities that should be accomplished in each life cycle phase, and discusses the DCSPER MANPRINT Assessment process. It has been updated to reflect the guidance contained in the latest approved DoDD 5000.1 and DoDR 5000.2-R.

APPROPRIATE USES:
This Handbook is designed as a guide for those individuals responsible for coordinating, guiding, implementing, and managing MANPRINT in the acquisition of both automated information systems (AIS) and materiel systems.

EQUIPMENT REQUIRED:
None.

INPUTS REQUIRED:
None.

PROCESSING TECHNIQUES:
None.

OUTPUT:
General information about: MANPRINT; System MANPRINT Management Plan (SMMP); Missions and Compositions of MANPRINT Working Integrated Concept Teams (ICT)/ Integrated Product Teams (IPT); Life Cycle Phases; MANPRINT Assessment Process.

USES OF OUTPUT:
Guidance for a comprehensive management and technical strategy for human systems integration (HSI) early in the acquisition process.

DOCUMENTATION:
Self-contained.

ALTERNATIVE/COMPARABLE APPROACHES:
None.

STAGE OF DEVELOPMENT:
Completed. Some changes to the Handbook may be required as revisions evolve

to other publications, such as AR 602-2 and the applicable DoD directives.

VALIDATION:
None.

COMMENTS:
This Handbook replaces the MANPRINT User's Source Guide (MUSG).

OVERALL CATEGORY: Handbook/Guide/Course
STATUS: Available

TITLE: Human Factors Design Guide (HFDG)

SPONSOR: FAA William J Hughes Technical Center
POINT OF CONTACT: Dr Richard (AFHF Program Manager) Mogford / 609-485-5809
RECORD NO.: HSI00133

GENERAL OVERVIEW:
This reference document provides design guidance information for human factors professionals to use to select, analyze, design, develop, and evaluate new and modified FAA systems and equipment. The HFDG, though generally applicable, was specially developed for ground systems and equipment such as that which is managed and maintained by Airway Facilities. The guide covers a broad range of human factors topics that pertain to automation, maintenance, human interfaces, workplace design, documentation, system security, safety, the environment, and anthropometry. This document also includes extensive human-computer interface guidance.

APPROPRIATE USES:
Used by government and contractor human factors professionals as an aid in performing their human factors duties associated with the acquisition of FAA systems, equipment, and facilities.

EQUIPMENT REQUIRED:
No special equipment is necessary to use this document. There is currently a CD-ROM version available, requiring CD-ROM and sound card capability.

INPUTS REQUIRED:
Professional understanding of the Human Factors Engineering applied to acquisition of commercial-off-the-shelf, non-developmental items, and developmental systems.

PROCESSING TECHNIQUES:
The document requires no special processing techniques.

OUTPUT:
Guidelines for professional use.

USES OF OUTPUT:
System/equipment selection, development, evaluation.

DOCUMENTATION:
Self-contained.

ALTERNATIVE/COMPARABLE APPROACHES:
Complements Human Factors selection, development, and evaluation processes.

STAGE OF DEVELOPMENT:
Initial version of the document is completed; first revision of the CD-ROM version is available.

VALIDATION:
Has had broad review by selected human factors experts.

COMMENTS:
This Guide is user-friendly, and consolidates a great deal of information from many sources.

Alternate POC: Dr. Earl Stein (ATHF Program Manager), 609-485-6389.

OVERALL CATEGORY: Handbook/Guide/Course
STATUS: Available

TITLE: Integrated Manpower, Personnel and Comprehensive Training & Safety (IMPACTS) Executive Seminar

SPONSOR: Human Systems Center - IMPACTS Office
POINT OF CONTACT: Lt Col Bill Rimpo / 210-536-6401, DSN: 240-6401
RECORD NO.: HSI00084

GENERAL OVERVIEW:
The IMPACTS Executive Seminar is a one-to-four-hour course designed to provide an overview of human systems integration considerations in AF systems acquisition. Lessons focus on the IMPACTS process and analysis in relation to the Defense Acquisition Process; the six IMPACTS elements (manpower, personnel, training, safety, human factors, health hazards); tools, techniques, and databases for IMPACTS analyses; and organizational functional relationships in the IMPACTS process, with emphasis on the roles of program managers and acquisition executives, the IMPACTS Program Planning Team, and the IMPACTS Program Plan in facilitating integration of IMPACTS requirements.

APPROPRIATE USES:
The Executive Seminar is intended for General Officers, Senior Executive Service professionals, DPMLs, and SPDs and SPMs. The objective is to familiarize them with the six IMPACTS elements and their interactions; the benefits of an IMPACTS Program; available tools, techniques and databases for analyses; and basic HSI requirements within the systems acquisition process.

EQUIPMENT REQUIRED:
No student-provided equipment is required. The instructor will require an overhead projector and a TV and VCR.

INPUTS REQUIRED:
No student inputs are required.

PROCESSING TECHNIQUES:
Current mode of instruction is traditional classroom, lecture, exercise.

OUTPUT:
Output is basic familiarization with the concept of human systems integration and its implementation by the Air Force. A copy of the course is provided for each student to keep.

USES OF OUTPUT:
Students should be aware of basic DoD and Air Force HSI requirements, and understand the benefits of the IMPACTS Program.

DOCUMENTATION:
DoDD 5000.2; DoDI 5000.2 & 2M; AFR25-1 V5.

ALTERNATIVE/COMPARABLE APPROACHES:
Army MANPRINT courses.

STAGE OF DEVELOPMENT:
Under development. For more information, please contact the POC.

COMMENTS:

None.

OVERALL CATEGORY: Handbook/Guide/Course
STATUS: Available

TITLE: Integrated Manpower, Personnel and Comprehensive Training & Safety (IMPACTS) Familiarization Course

SPONSOR: Human Systems Center - IMPACTS Office
POINT OF CONTACT: Lt Col Bill Rimpo / 210-536-6401, DSN: 240-6401
RECORD NO.: HSI00083

GENERAL OVERVIEW:
The IMPACTS Familiarization Course is designed to provide an overview of human systems integration considerations in AF systems acquisition. Lessons focus on the IMPACTS process and analysis in relation to the Defense Acquisition Process; the six IMPACTS elements (manpower, personnel, training, safety, human factors, health hazards); tools, techniques, and databases for IMPACTS analyses; and organizational functional relationships in the IMPACTS process, with emphasis on the roles of the MAJCOM IMPACTS OPR, the IMPACTS Program Planning Team, and the IMPACTS Program Plan in facilitating integration of IMPACTS requirements.

APPROPRIATE USES:
The Familiarization Course is intended for MAJCOM IMPACTS OPRs or planning team members, SPO IMPACTS OPRs or analysts, Technical Planning Integrated Project Team (TPIPT) members, Deputy Program Manager for Logistics, and Air Staff Element OPRs. The objective is to familiarize them with the six IMPACTS elements and their interactions; the structure of an IMPACTS Program Plan; how to utilize the available tools, techniques and databases; and how to conduct an IMPACTS Planning Team.

EQUIPMENT REQUIRED:
No student-provided equipment is required. The instructor will require an overhead projector and a TV and VCR.

INPUTS REQUIRED:
No student inputs are required.

PROCESSING TECHNIQUES:
Current mode of instruction is traditional classroom, lecture, exercise.

OUTPUT:
Output is basic familiarization with the concept of human systems integration and its implementation by the Air Force. A copy of the course is provided for each student to keep.

USES OF OUTPUT:
Students should be able to form and lead, or participate knowledgeably, in an IMPACTS Planning Team.

DOCUMENTATION:
DoDD 5000.2; DoDI 5000.2 & 2M; AFR25-1 V5.

ALTERNATIVE/COMPARABLE APPROACHES:
Army MANPRINT courses.

STAGE OF DEVELOPMENT:
Requires update before each delivery. For more information, call:
Lt Col Bill Rimpo at (210) 536-6441 / DSN 240-6441.

NOTE: Funded by requester.

COMMENTS:
This course is currently consolidated into a one-day seminar which is intended to be a top-level overview of HSI. The course is in the process of revision. When updated, it will be expanded to a 40-hour course, providing more detailed training. The entire program is now under the direction of HQ Human Systems Center / Director of Planning and Requirement (HQ HSC/XR).

OVERALL CATEGORY: Handbook/Guide/Course
STATUS: Available

TITLE: Level I Ergonomics Methodology Guide for Maintenance/Inspection Work Areas

SPONSOR: Institute for Environment, Safety and Occupational Health Risk Analysis
POINT OF CONTACT: Maj Katharyn A Grant / 210-536-6116, DSN: 240-6116
EMAIL: kathy.grant@guardian.brooks.af.mil
RECORD NO.: HSI00189

GENERAL OVERVIEW:
This Guide providesa methodology to allow technicians with minimal training in ergonomics to identify risk factors for work-related musculoskeletal disorders, select practical control methods, facilitate implementation of modifications, and measure the impact of improvements to U.S. Air Force maintenance/inspection workplaces .

APPROPRIATE USES:
Identification and control of risk factors associated with the development of work-related musculoskeletal disorders in workers employed in maintenance/inspection (industrial) work areas.

EQUIPMENT REQUIRED:
None

INPUTS REQUIRED:
User completes Level I Ergonomics Assessment Checklist based on observation of work activities and discussions with workers and supervisors.

PROCESSING TECHNIQUES:
Checklist provides scoring algorithm for establishing corrective action priorities for risk factors identified using the Checklist.

OUTPUT:
Results of assessment indicate whether the job presents risk factors for muscoloskeletal disorder development. If yes, the results indicate what part(s) of the job is the primary source of risk factors, and what part(s) of the body should be targeted when identifying controls/job improvements. The methodology also enables the user to match hazards identified during the assessment to controls that can reduce or eliminate the hazards.

USES OF OUTPUT:
Output (list of risk factors and possible corrective actions) can be provided to work area supervisors for consideration/implementation.

DOCUMENTATION:
AL/OE-TR-1996-0158 V. 4A, "Preventing Work-Related Musculoskeletal Illnesses Through Ergonomics: The Air Force PREMIER Program, Volume 4A: Level I Ergonomics Assessment.Methodology Guide for Maintenance/Inspection Work Areas"

ALTERNATIVE/COMPARABLE APPROACHES:
Although many checklists/approaches have been developed to identify risk factors associated with work-related musculoskeletal disorders (e.g., OSHA, 1995; Keyserling, et al., 1993), none lead the user through the complete risk factor abatement process (identification of risk factors, evaluation of severity, development of potential controls).

STAGE OF DEVELOPMENT:
Complete (software to accompany product is under development).

VALIDATION:
Formal testing and validation efforts are documented in: AL/OE-TR-1996-0158 V. 4B, "Research Report for Level I Ergonomics Assessment Methodology Guide for Maintenance/Inspection Work Areas".

COMMENTS:
Can be downloaded from AF Ergonomics Online Website:
http://usafsg.satx.disa.mil/hscoemo.htm

OVERALL CATEGORY: Handbook/Guide/Course
STATUS: Available

TITLE: MANPRINT in Test and Evaluation

SPONSOR: Army Research Laboratory (ARL/HRED)
POINT OF CONTACT: Integration Methods Branch Chief / 410-278-6237, DSN: 298-6237
RECORD NO.: HSI00071

GENERAL OVERVIEW:
This method consists of two equations for predicting manned system performance, given sample data which describes soldier performance and hardware and software reliability. The first equation calculates the effectiveness of the system by numerical answer to the question, "How well does the system work when it works?" The second equation uses operating times for tasks (including the seven maintenance tasks described in MIL-STD-721), stand-by time, corrective and preventive maintenance times, and administrative and logistic down time. Those times are used to calculate the availability of the manned system (or the numerical answer to the question, "How often does the system work?"). The document explains the construction of the two equations and provides detail of calculating the soldier performance terms in each equation together with illustrations.

APPROPRIATE USES:
This method is appropriate for planning a full-scale MANPRINT evaluation of a soldier-machine system. All six MANPRINT domains are addressed and performance effects of those six domains can be calculated. The reference contains both explanation and example.

EQUIPMENT REQUIRED:
The equipment required to use this method are photocopies of the worksheets from the reference noted in this summary.

INPUTS REQUIRED:
The inputs necessary for this method are soldier performance data (time and accuracy of critical operations and maintenance tasks; soldier aptitude data (Armed Services Vocational Aptitude Battery (ASVAB) Profile); training data including time, cost, and end-of-training comprehension test scores; human factors engineering analysis; a safety assessment report; and a health hazard assessment report.

PROCESSING TECHNIQUES:
The processing of the input is the completion by hand of the worksheets from the reference noted in this summary.

OUTPUT:
The outputs consist of probabilities of correct soldier performance of each critical operations and maintenance task within time constraints; probabilities of correct soldier performance of all critical operations and maintenance tasks within time constraints; the system effectiveness (including soldier performance); and the system availability (including soldier performance).

USES OF OUTPUT:
The output of this method is used to evaluate quantitatively how well and how often a soldier-machine system will work in the field.

DOCUMENTATION:

Lowry, J. and Seaver, D., "Handbook for Quantitative Analysis of MANPRINT Consideration in Army Systems," ARI Research Product 88-15, 1986.

ALTERNATIVE/COMPARABLE APPROACHES:
Scott, J., et al., "Task Aptitude Template: A MANPRINT Methodology for Identifying Aptitude-Sensitive Critical Tasks," Draft Report, San Diego, CA: Cubic Defense Systems, Inc., Human Resources Test and Evaluation Systems (HRTES), 1987.

STAGE OF DEVELOPMENT:
To obtain, request AD A199620 (ARI RP-8815) from Defense Technical Information Center, Reference and Retrieval Division, ATTN: DTIC-BR, 8725 John J. Kingman Rd., Ste. 0944, Ft. Belvoir, VA 22060-6218. Phone: (703) 767-8274 / DSN 427-8274.

COMMENTS:
The first reference under Alternative Approaches addresses personnel and training. It identifies which critical tasks of a developing system show performance differences as a function of soldier aptitude and training. The second reference under Alternative Approaches describes the predecessor methodology to this handbook. HRTES was prepared for essentially the same purpose and scope.

OVERALL CATEGORY: Handbook/Guide/Course
STATUS: Available

TITLE: National Plan for Civil Aviation Human Factors: An Initiative for Research and Application

SPONSOR: Federal Aviation Administration
POINT OF CONTACT: Dr Mark Hoffmann / 202-267-7125
EMAIL: hoffmann@mail.hq.faa.gov
RECORD NO.: HSI00107

GENERAL OVERVIEW:
The purpose of the National Plan for Civil Aviation Human Factors is to describe the human factors actions required by the aviation community to achieve and maintain the world's safest and most efficient National Airspace System (NAS). It provides a framework for the aviation community to initiate research and management activities to produce and use technical findings. Two goals are paramount - reducing error in human-system interactions and increasing the efficiency of human-system performance. Attaining these goals requires the following four iterative activities:

1. Identifying operational needs and problems involving human performance.
2. Guiding research programs in federal organizations to address operational priorities.
3. Eliciting the participation of the nation's top scientists and aviation professionals in government, industry, and universities.
4. Facilitating transfer of research results to the operational community.

The plan outlines a coherent national agenda containing two major elements. The first element focuses on five research thrusts:

1. Human-centered automation.
2. Selection and training.
3. Human performance assessment.
4. Information management and display
5. Bioaeronautics.

The second element focuses on opportunities for improving the application of research results to planned and ongoing programs. Implementation of four manage actions is outlined:

1. Establish and implement the policies and progresses necessary to create an environment for change.
2. Develop human factors education and training programs at all levels.
3. Equip personnel and facilities with modern tools and techniques of the human factors engineering discipline.
4. Develop and maintain the infrastructure to translate and disseminate human factors products, and guide the organization's functions involving the human component.

APPROPRIATE USES:
The National Plan is used for design and implementation of Human-System Integration programs. It is used to provide the structure for institutionalizing the consideration of human performance issues and reducing many of the operationally significant human performance challenges facing the nation's aviation system. The National Plan is used to promote coordination between governmental departments and organizations; and between government, private industry and academia.

DOCUMENTATION:
National Plan for Civil Aviation Human Factors, March 1995.

ALTERNATIVE/COMPARABLE APPROACHES:
Not Applicable.

STAGE OF DEVELOPMENT:
The original Plan was published in November 1990. This update to the Plan, published in March 1995 is completed. The current version of the National Plan is also available on the Internet via:
HHTP:/WWW.FAA.GOV/AAR/Human-Factors/Welcome.HT

COMMENTS:
The revised National Plan re-emphasizes human performance from a NAS perspective where the system encompasses the broadest interests of the aviation community including flight deck, aircraft cabin, air traffic control, airway facilities, aircraft maintenance, and commercial and general aviation operations, as well as the regulatory and organizational activities affecting these elements. This initiative describes the contributions of NASA, FAA, and DoD, along with structured recommendations from the private sector of the aviation community. It addresses current and future research needs and required implementation activities arising from discussions within the public and private sectors of the aviation community.

OVERALL CATEGORY: Handbook/Guide/Course
STATUS: Available 1998

TITLE: NATO Research Study Group 24, Human Engineering Testing and Evaluation

SPONSOR: AC/243 DRG P.8 RSG.24, Human Engineering Testing and Evaluation
POINT OF CONTACT: Dr James C Geddie / 817-288-9572, DSN: 738-9572
EMAIL: txh7800@texcom-hood.army.mil
RECORD NO.: HSI00139

GENERAL OVERVIEW:
NATO Research Study Group 24, Human Engineering and Evaluation (RSG.24) has as its primary goal developing a set of NATO-sanctioned guidelines for performing human engineering testing and evaluation.

The original plan called for the Group to address five data categories: Workload, Test Participant Characteristics, User Subjective Judgment, Engineering Measurement, and Human Task Performance. One of the agreements among members at the beginning of the Group effort was that the methodology and technology recommended in the guidelines must be widely used and recognized by all member nations. The restriction essentially precluded incorporation of any recent or cutting-edge technology; so content from a workshop to be held in June, 1997, at NATO HQ in Brussels is intended to provide a way to address that shortcoming. The proceedings of the workshop will be published as a stand-alone document, but will also provide the basis for an appendix to the guidelines document to refer users to methods and techniques which may become widely known and commonly used in the forseeable future, and should be considered for inclusion in any future revisions of the guidelines. It is the RSG's intent to include this content in a form that encourages periodic updates, so that its value doesn't erode over time.

APPROPRIATE USES:
The purpose of the guidelines is to try to make more efficient use of test data to support purchase decisions, co-development, co-production, and other cooperative ventures among NATO nations. If properly used, the guidelines will identify and provide information on methods and procedures that are generally recognized and used by NATO weapons-producing nations in doing human engineering testing and evaluation, and will facilitate using each other's data to avoid duplicative testing, and to help NATO and other purchasers be better shoppers.

EQUIPMENT REQUIRED:
T&E generic.

INPUTS REQUIRED:
T&E generic.

PROCESSING TECHNIQUES:
T&E generic.

OUTPUT:
T&E generic.

USES OF OUTPUT:
Acquisition and procurement decisions.

DOCUMENTATION:
T&E generic

ALTERNATIVE/COMPARABLE APPROACHES:
Chaos

STAGE OF DEVELOPMENT:
80% complete

VALIDATION:
Approval by NATO

COMMENTS:

OVERALL CATEGORY: Information Service Center

STATUS: Available

TITLE: Crew System Ergonomics Information Analysis Center (CSERIAC)

SPONSOR: Defense Technical Information Center / Air Force Research Laboratory

POINT OF CONTACT: Mr Matt Kolleck / 937-255-4842, DSN: 785-4842

RECORD NO.: HSI00050

GENERAL OVERVIEW:
CSERIAC is a DoD Information Analysis Center (IAC) that provides ergonomic information analysis services to support research, design, and development of space, air, surface, and subsurface crew systems.

APPROPRIATE USES:
CSERIAC functions as a gateway to worldwide sources of behavioral, biomedical, and engineering information for engineers, designers, and human factors specialists. CSERIAC primarily supports the DoD and other government organizations and their contractors. CSERIAC also is available to other types of users, including academic and corporate, at both the domestic and international levels to the extent practicable within the DoD security guidelines and DoD policy regarding the handling of information on military critical technologies.

EQUIPMENT REQUIRED:
There is no equipment required to use CSERIAC.

INPUTS REQUIRED:
The user must contact CSERIAC.

PROCESSING TECHNIQUES:
CSERIAC provides various products and services on a cost-recovery basis in response to expressed or anticipated needs. These information products and services include handbooks and data books, state-of-the-art reports and technology assessments, research directories, abstracts, indexes, symposia, panels, workshops, and short courses. CSERIAC will offer a variety of services including customized responses to technical and bibliographic inquiries, support for revision and development of military standards and specifications, and maintaining and implementing computer-based models of human performance.

DOCUMENTATION:
Hennessy, R.T., "CSERIAC: Gateway to Ergonomic Information," Human Factors Society Bulletin, 32 (2), 1-4, 1989.

ALTERNATIVE/COMPARABLE APPROACHES:
Information Analysis Centers (IAC) are DoD-sponsored centers which provide scientific, technical, and support services to government, industry, and academic communities. Each IAC serves a vital technical or mission area.

STAGE OF DEVELOPMENT:
CSERIAC is fully operational. To obtain information, contact:

Mail: AFRL/HEC/CSERIAC
Bldg. 196, Rm. 8, 2261 Monahan Way
Wright-Patterson AFB, OH 45433-7022

Phone: 937-255-4842 / DSN 785-4842
Fax: 937-255-4823 / DSN 785-4823

COMMENTS:
None.

OVERALL CATEGORY: Information Service Center

STATUS: Available

TITLE: Defense Modeling and Simulation, Tactical Technology Information Analysis Center (DMSTTIAC)

SPONSOR: DTIC IAC / IIT Research Institute
POINT OF CONTACT: Mr Hunter Chockley / 205-880-0884
EMAIL: hunter@iitri.com
RECORD NO.: HSI00173

GENERAL OVERVIEW:
DMSTTIAC is a DoD Information Analysis Center (IAC) that provides technical information services relative to Modeling. Simulation and Training, Test and Evaluation, Tactical Technology, and Special Operations.

APPROPRIATE USES:
DMSTTIAC pushes the edge of technology in supporting key DoD initiatives in the technical domains of Modeling, Simulation and Training, Test and Evaluation, Tactical Technology, and Special Operations. This includes performing advanced studies, analyses, and assessments; supporting experimentations, exercises, and demonstrations; network planning and design; and strategic and mission planning.

EQUIPMENT REQUIRED:

INPUTS REQUIRED:

PROCESSING TECHNIQUES:
DMSTTIAC provides various products and services on a cost-recovery basis.

OUTPUT:
DMSTTIAC's products and services include: state-of-the-art reviews, technical assessments, peer reviews, databases, conferences, and technical and bibliographic searches. Additionally, DMISTIAC has a very active Technical Area Task (TAT) effort which involves: extended analysis and independent assessments, tailored and responsive to the needs of the customer, pushing state-of-the-art technologies, and addressing new initiatives/concepts.

USES OF OUTPUT:
Assist the user in providing the needed scientific and technical information within the domains of DMSTTIAC.

DOCUMENTATION:
A listing of the available DMSTTIAC products can be found on the DMSTTIAC Home Page: http://dmsttiac.iitri.com.

ALTERNATIVE/COMPARABLE APPROACHES:

STAGE OF DEVELOPMENT:

COMMENTS:
The DISTRIBUTION CODE for DMSTTIAC actually varies depending upon the documentation/data service requested.

The user can contact DMSTTIAC by accessing the Internet Home Page (http://dmsttiac.iitri.com), or by calling the Answer Desk (312-567-4557) or Product Distribution (312-567-4587).

OVERALL CATEGORY: Information Service Center

STATUS: Available

TITLE: MATRIS Office

SPONSOR: Defense Technical Information Center (DTIC)
POINT OF CONTACT: Ms E Byars Vicino / 619-553-7000, DSN: 553-7000
EMAIL: bvicino@dticam.dtic.mil
RECORD NO.: HSI00165

GENERAL OVERVIEW:
The MATRIS Office of the Defense Technical Information Center (DTIC) provides:

I. A centralized source of people-related research information:

Manpower & Personnel	Human Factors/Human Systems Integration
Training Technology	Biomedical
Training Systems	Safety & Survivability
Human Performance	

II. Business assistance:
- DoD SBIR/STTR Electronic Forum
- DoD Technology Transfer Research Database

Services include:
- Research information, with points of contact
- Inhouse search and retrieval services
- Online access and Internet Home Page
- Reports and publications
- Database development and maintenance
- Web Site development

The MATRIS Web Site is publicly accessible, and contains several focused R&D databases, as well as electronic versions of MATRIS publications.

MATRIS's large, inhouse database, which focuses on "people-related" research, is available to U.S. government agencies and their contractors. Database development and maintenance, and Web Site development and housing services are similarly restricted.

APPROPRIATE USES:
MATRIS services are designed to:
- Prevent duplication of research through sharing of R&D information;
- Facilitate the ability of researchers and developers to build upon lessons learned;
- Fulfill Department of Defense (DoD) subject matter search requirements;
- Enhance research coordination within and outside the DoD.

EQUIPMENT REQUIRED:
Personnel computer and modem for access to the main database; additionally, an Internet connection for access to the MATRIS Web Site.

INPUTS REQUIRED:
The MATRIS inhouse database. Online access is provided to qualified users; however, staff is available to perform MATRIS database searches, which can save both time and online connect fees.

PROCESSING TECHNIQUES:

The MATRIS Web Site can be accessed using any of the common Web browsers. The MATRIS database runs on BASISPlus (a relational database product).

OUTPUT:
Database records can be downloaded from the MATRIS Web Site. Reports prepared by the MATRIS staff can be provided in hardcopy or electronic format. MATRIS also produces periodic hardcopy publications: "Directory of Design Support Methods"; "Directory of Researchers"; "Index of Non-Government Standards on Human Engineering Design Criteria and Program Requirements/Guidelines".

USES OF OUTPUT:
(See above.)

DOCUMENTATION:
MATRIS products and services are described on the Web Site. Brochures are also available.

ALTERNATIVE/COMPARABLE APPROACHES:

STAGE OF DEVELOPMENT:

COMMENTS:

OVERALL CATEGORY: Standardization Document
STATUS: Available

TITLE: DOD-HDBK-743A, Anthropometry of U.S. Military Personnel

SPONSOR: Army Soldier Systems Command
POINT OF CONTACT: Ms Mary T Lapham / 508-651-4081, DSN: 256-4081
RECORD NO.: HSI00125

GENERAL OVERVIEW:
Presents body size information on the military personnel of the United States in the form of anthropometric data. Introductory material describes uses of the data, importance of military anthropometry, availability of military anthropometric data, and previous publications of such data. An extensive summary of sources is provided, including fifteen major anthropometric surveys, five anthropometric studies of specific body parts, and fifteen other anthropometric surveys and studies. Brief definitions and illustrative figures describe 203 body measurements. Over 400 pp of statistical and percentile values for the 203 (nude) body measurements form the major portion of the handbook. (546 pp)

APPROPRIATE USES:
Used for human factors engineering applications in the design and development of military systems, equipment, and facilities and in the design and sizing of military clothing and personal equipment. The anthropometric data included in MIL-HDBK-759C are limited to only the 5th and 95th percentile values for selected body dimensions. This handbook not only serves as a supplement to MIL-HDBK-759C as a source of anthropometric data, it presents it in sufficient detail, and in a format readily usable by those who require body size information for design, sizing, and human engineering purposes. Essentially, DOD-HDBK-743A is the authoritative Defense standardization source of such data. DOD-HDBK-743A is intended for guidance only, not for citation as a contractual requirement. If it is cited contractually, the contractor is not obligated to comply with its provisions.

DOCUMENTATION:
N/A

ALTERNATIVE/COMPARABLE APPROACHES:
As noted in "Appropriate Uses," above, some anthropometric data are included in MIL-HDBK-759C and are limited to only the 5th and 95th percentile values for selected body dimensions. That source can be entirely satisfactory for application to simple design problems involving physical access and clearance where system performance requirements are expressed in terms of operability by users with applicable 5th and 95th percentile body dimensions. Where such problems involve measurements not contained in MIL-HDBK-759C, or where system requirements focus on ranges other than the 5th through 95th percentiles, that and similar documents may not be suitable as anthropometric data sources. A summary of other approaches would probably be too extensive to appear here; however, as a general observation, alternatives could include using data from anthropometric surveys, some of which served as sources of data contained in the handbook. A bibliography of such sources appears in the handbook. Data is also available in tape form that has been prepared for the Armstrong Laboratory at Wright-Patterson Air Force Base, OH, and are available from DTIC. Most of these could be considered as archival, since they reflect data banks from 1946-1977 surveys. More recent data in electronic form is available via computerized tools and techniques summarized elsewhere in this Directory.

STAGE OF DEVELOPMENT:
This is a mature handbook. Revision A, approved 13 February 1991, is the current edition.

ORDERING INFORMATION:
See "Ordering Information for DoD Standardization Documents" at the front of this section.

VALIDATION:
Required February 1996.

COMMENTS:
Technical point of contact: Dr. Claire Gordon
US Army Soldier Systems Command
Natick, MA
Voice: 508-651-5429, 4430 / DSN 256-5429, 4430
FAX: 508-651-5104

OVERALL CATEGORY: Standardization Document
STATUS: Available

TITLE: DOD-HDBK-763, Human Engineering Procedures Guide

SPONSOR: Army Aviation and Missile Command
POINT OF CONTACT: Ms Glenda P Rogers / 205-955-6125, DSN: 645-6125
EMAIL: gprogers@redstone.army.mil
RECORD NO.: HSI00127

GENERAL OVERVIEW:
This handbook was prepared in 1987 to supplement the material in MIL-H-46855B, Human Engineering Requirements for Military Systems, Equipment, and Facilities, and provides basic information on human engineering techniques and procedures that may be used by requiring organizations when imposing that specification and its related data item descriptions, and by performing organizations when complying with that specification and its related data item descriptions. The handbook focuses on two major areas: programmatic procedures (for both requiring and performing organizations); and human engineering techniques. The handbook is now considered obsolescent for reasons explained in COMMENTS. (250 pp)

APPROPRIATE USES:
This handbook should be used with care. Sections 1-4 present introductory material. Section 5, Human Engineering Procedures for Requiring Organizations, and Section 6, Human Engineering Procedures for Performing Organizations, should not be used as authoritative sources for programmatic guidelines, except to the degree that generic principles might apply to today's acquisition process. In its current forms, these two sections probably should be avoided. Section 7, Human Engineering Techniques, may be used to obtain descriptions, procedures, use, comparison to other techniques, and controlling agencies for traditional and some modern tools and techniques. DOD-HDBK-763 is intended for guidance only, not for citation as a contractual requirement. If it is cited contractually, the contractor is not obligated to comply with its provisions.

DOCUMENTATION:
N/A

ALTERNATIVE/COMPARABLE APPROACHES:
For now, DoD and Service regulations governing human engineering programs and their place in HSI initiatives would be a wise substitute for Sections 5 and 6. This Directory of Design Support Methods could be used as a supplement to Section 7 to the degree that human engineering tools and techniques are covered.

STAGE OF DEVELOPMENT:
Approved and available, but overage.

ORDERING INFORMATION:
See "Ordering Information for DoD Standardization Documents" at the front of this section.

VALIDATION:
Was required in February 1992, but not accomplished since the handbook was deemed to be obsolescent and administratively overage. Revision was not undertaken since that time because funds were not available to do so. See COMMENTS.

COMMENTS:
As noted in the GENERAL OVERVIEW, DOD-HDBK-763 is essentially an instructional manual to facilitate use of MIL-H-46855B; however, in 1994, MIL-H-46855B was revised and re-designated as MIL-STD-46855, while retaining its title. More important, as a result of implementing standardization reform, MIL-STD-46855 was converted to a handbook.

The first emphasis area of DOD-HDBK-763 --programmatic procedures-- is not truly current. The acquisition process has changed considerably since 1987 when DOD-HDBK-763 was published. The data item descriptions shown in DOD-HDBK-763 have been revised twice and re-numbered. Two of the DIDs have been canceled. Organizations, documents (standards, regulations, DIDs), and the way in which the remaining seven DIDs are used has also changed. As a result, this portion of the handbook (Sections 5 and 6) is not very useful in today's acquisition process, except where generic principles might be applied.

The second emphasis area of DOD-HDBK-763 --human engineering techniques-- reflects the state-of-the-art as it existed in 1987. Some of the computerized tools have been updated; new ones have emerged. DOD-HDBK-763 describes 23 human engineering analysis techniques, 13 human engineering design support techniques, and 20 test and evaluation techniques. Since only a half-dozen of these 56 human engineering tools and techniques are covered by the current Directory of Design Support Methods, the descriptions of tools and techniques (Section 7 of DOD-HDBK-763) probably still serve a useful function.

DOD-HDBK-763 is being revised and combined with MIL-HDBK-46855. The consolidated handbook, MIL-HDBK-46855A, is expected to appear in coordination draft form during the Summer of 1998. Upon approval of MIL-HDBK-46855A, DOD-HDBK-763 will be canceled, probably in late 1998 or early 1999.

Technical Point of Contact: Mr. Tom Cook, ARL Field Element - AMCOM
Voice: 205-876-2048 / DSN 746-2048
FAX: 205-842-9451
E-mail: cook-tc@redstone.army.mil

OVERALL CATEGORY: Standardization Document
STATUS: Available

TITLE: Index of Non-Government Standards on Human Engineering Design Criteria and Program Requirements/Guidelines

SPONSOR: DoD Human Factors Engineering Technical Advisory Group
POINT OF CONTACT: Ms E Byars Vicino / 619-553-7000, DSN: 553-7000
EMAIL: bvicino@dticam.dtic.mil
RECORD NO.: HSI00136

GENERAL OVERVIEW:
This 25-page tabulation of over 450 current HFE non-government standards (NGS) lists the subject area covered by the standard (e.g., machinery, color and marking), title of the standard, document identifier (which includes the standards body responsible), and organizational addresses of those standards bodies. Those NGSs cited by DoD HFAC documents are identified, as are those NGSs that have been adopted by DoD.

Document selection for this index is a function of how one defines "human engineering," "human factors," "ergonomics," and "standard." Some non-human factors documents, cited by human factors standards, appear in the list and include general documents (e.g., metric system usage) and focused documents (e.g., acoustical measurements).

As a general rule, standards focused on human performance, effects, or exposure were included; standards aimed at equipment were not, unless the equipment might be used by military personnel for mission accomplishment, or involves measuring devices/instrumentation used in human factors testing.

Since the designation of documents as standards by non-government standards bodies tend to be somewhat flexible, the scope of the listing has been kept quite loose and includes standards, specifications, recommended practices, codes, guides, handbooks, etc. For those documents not specifically identified as standards, the general guideline for inclusion in this index was that they are written in the manner of standards; i.e., they contain provisions with traditional action verbs (shall/should/may). Others were prepared by standards organizations, and, presumably, proceeded through a recognized due process-type procedure for consensus acceptance. The Index was also limited to documents designated by numbered identifiers.

Draft standardization documents are also included in the listing, even though not all of these documents are available. This was done to identify (1) current documents being revised, and (2) new documents that will be available in the near future.

APPROPRIATE USES:
This index can be used as a comprehensive, but not all-inclusive, list of human factors standardization documents for overview purposes, or for ordering a specific document by using its identifier in the main listing to determine its source and consulting an organization address listing provided at the end of the Index.

Neither the distributing Point of Contact (POC) for this Index, nor the technical POC listed, can provide any of the source documents.

EQUIPMENT REQUIRED:
None; hard copy document.

DOCUMENTATION:
In addition to well-known and currently used standards, representative sources for this Index included:

- Draft HFAC Standardization Document Program Plan, Revision 9
- DoD Index of Specifications and Standards
- Non-government standards referenced in HFAC standards and handbooks, databases, and standards organizations' catalogs

ALTERNATIVE/COMPARABLE APPROACHES:
Searches of databases and standards organizations' catalogs.

STAGE OF DEVELOPMENT:
The Index, produced by the Technical Society/Industry (TS/I) sub-TAG of the DoD HFE TAG, was submitted to, and accepted by, the TAG Operating Board, 7 Nov. 1995. The Index described here is a revision, prepared by the TS/I SubTAG and submitted to the DoD HFE TAG Operating Board on 13 May 1997.

ORDERING INFORMATION:
Order from the POC shown at the beginning of this record.

COMMENTS:
The Index was intended to serve as a stopgap resource until the National Standards System Network (NSSN) was loaded, up, running, and publicized -- around the end of 1997. The NSSN Basic service now includes a database searchable by keyword, and includes industry, government, and commercial standards (e.g., DoD, ASTM, ISO, SAE, NFPA). Accordingly, the advantages of the Index are somewhat diminished, and further revisions are not anticipated at this time.

The individual listed in "Point of Contact Information" represents the distributing organization.

Technical POC:
Mr. Gerald Chaikin, TS/I SubTAG, DoD HFE TAG
Voice: (205) 876-3176 / FAX: (205) 876-3177
E-mail: gchaikin

OVERALL CATEGORY: Standardization Document
STATUS: Available

TITLE: MANPRINT Guidebook for Systems' Design & Assessment

SPONSOR: Army Deputy Chief of Staff for Personnel (DCSPER)
POINT OF CONTACT: Ms Peggy Simmons / 703-695-7035, DSN: 225-7035
EMAIL: simmons@hqda.army.mil
RECORD NO.: HSI00191

GENERAL OVERVIEW:
Guidebook provides MANPRINT domain experts, program managers, and requirements offices/concept developers with checklists of domain-specific items covering possible design elements of analysis, features, and issues when participating in Integrated Concept Teams, Integrated Product Teams, in test planning, and when assessing a system.

APPROPRIATE USES:
This paper tool is intended to be a training aid for the new MANPRINT practitioner, and a convenient reminder checklist for an experienced MANPRINT assessor. It provides a detailed domain-specific listing of what one should look for in assessing a system. As such, the checklist makes up a comprehensive rating guide and gives the practitioner a feel for the topical coverage of each domain.

EQUIPMENT REQUIRED:
N/A

INPUTS REQUIRED:
N/A

PROCESSING TECHNIQUES:
N/A

OUTPUT:
Basis for domain assessments.

USES OF OUTPUT:
Conducting MANPRINT domain assessments; training aid; comprehensive guide for program managers.

DOCUMENTATION:
N/A

ALTERNATIVE/COMPARABLE APPROACHES:
N/A

STAGE OF DEVELOPMENT:
Completed.

VALIDATION:
N/A

COMMENTS:
Paper copy is 33 pages; also available electronically as a word document. Contact Ms. Peggy Simmons. Personnel Technologies Directorate, ODCSPER, HQDA, 703-695-7035 / DSN 225-7035 / FAX 703-697-1283.

OVERALL CATEGORY: Standardization Document
STATUS: Available

TITLE: MIL-HDBK-1473A, Color and Marking of Army Materiel

SPONSOR: Army Aviation and Missile Command
POINT OF CONTACT: Ms Glenda P Rogers / 205-955-6125, DSN: 645-6125
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RECORD NO.: HSI00114

GENERAL OVERVIEW:
Consolidates into a single document color and marking guidelines for different classes of materiel contained in numerous administrative and standardization documents. The handbook establishes general guidelines and serves as a convenient summary of color and marking practices (commodity and functional) as they apply to Army materiel. General color provisions of the handbook address controls and displays, and off-the-shelf equipment. General marking provisions address identification, shipment and storage, controls and displays, and labeling, lettering, and numeral design. Detailed provisions are largely weapon-oriented, e.g., towed artillery, multiple rocket launchers, missiles, rockets, missile ground support equipment, and small systems. Color and marking provisions also address meteorological equipment, machine tools, petroleum and related products, photographic and audio-visual equipment, and other diverse items. Functionally oriented detailed provisions focus primarily on safety signs. (34 pp)

APPROPRIATE USES:
The handbook provides guidance only for colors and markings -- not finishes, surface preparations, related treatments for preservation and coating, or special provisions specified by Army design activities. The handbook is not intended to apply to exterior colors of Army equipment under tactical conditions in active combat theaters of operation where such equipment may be painted Lusterless White in snow areas, or other colors or patterns deemed necessary for camouflage, or for compliance with host country requirements.

DOCUMENTATION:
N/A

ALTERNATIVE/COMPARABLE APPROACHES:
Use of the guidance documents (specifications, administrative documents, such as regulations and non-government standards), listed in the appendix, that served as sources for some of the provisions in the handbook.

STAGE OF DEVELOPMENT:
Approved and available.

ORDERING INFORMATION:
See "Ordering Information for DoD Standardization Documents" at the front of this section.

VALIDATION:
Not required until August, 2002.

COMMENTS:
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OVERALL CATEGORY: Standardization Document
STATUS: Available

TITLE: MIL-HDBK-1908A, Definitions of Human Factors Terms

SPONSOR: Army Aviation and Missile Command
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RECORD NO.: HSI00122

GENERAL OVERVIEW:
This handbook consolidates definitions of terms used in Defense human factors standardization (HFAC) documents by providing common meanings of such terms to ensure that they will be interpreted consistently and in the manner intended, thereby eliminating overlap, duplication, and conflict. As other HFAC documents were revised, they dropped the contents of their "Definitions" sections in favor of this handbook.

The "A" revision of this handbook (1) incorporated terms and definitions of MIL-STD-1789A, "Sound Pressure Levels in Aircraft," (not in the human factors standardization area), since that standard was consolidated into MIL-STD-1474D; (2) deleted terms and definitions that had been drawn from standards that have since been canceled; and cited additional non-government standards as supplemental sources.

Each term appears alphabetically, in bold face, followed by an italicized annotation of the application to which the definition was created to support; i.e., (1) general human engineering applications, (2) user/computer interface, (3) sound, noise, vibration, (4) display symbol information, and (5) acquisition. The definition that follows each boldfaced and annotated term does not apply to other applications. (42 pp).

APPROPRIATE USES:
Provides users of human factors standardization documents with definitions of human factors terms used therein; provides preparers of human factors standardization documents with definitions of terms to ensure that such terms in new documents will harmonize with accepted usage. DOD-HDBK-1908A is intended for guidance only, not for citation as a contractual requirement. If it is cited contractually, the contractor is not obligated to comply with its provisions.

DOCUMENTATION:
N/A

ALTERNATIVE/COMPARABLE APPROACHES:
Dictionaries (traditional and technical) could be used with some risk. The definitions contained in such dictionaries may differ from those in MIL-HDBK-1908, since the latter were carefully developed to support the meanings and contexts of what had been contractually binding provisions in the original source standards.

STAGE OF DEVELOPMENT:
Approved 25 June 1996.

ORDERING INFORMATION:
See "Ordering Information for DoD Standardization Documents" at the front of this section.

VALIDATION:

Not required until June 2001.

COMMENTS:

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OVERALL CATEGORY: Standardization Document
STATUS: Available

TITLE: MIL-HDBK-46855, Department of Defense Handbook: Human Engineering Guidelines for Military Systems, Equipment, and Facilities

SPONSOR: Army Aviation and Missile Command
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EMAIL: gprogers@redstone.army.mil
RECORD NO.: HSI00123

GENERAL OVERVIEW:
Describes the application of human engineering to the development and acquisition of military systems, equipment, and facilities, including work accomplished by a contractor or subcontractor in conducting a human engineering effort integrated with the total system engineering and development effort. Provides guidance for including human engineering in proposals, and in system, equipment, software, and facility analysis, design, and test. (32 pp)

APPROPRIATE USES:
When used, this handbook should be tailored for application to specific programs and the milestone phase of the program within the overall life cycle. The tailoring selectively applies methods, tables, sections, individual paragraphs or sentences, or a combination thereof, to identify important human engineering program actions consistent with avoiding unnecessary program costs. Tailoring guidance is contained in an Appendix. The handbook also provides a basis for respondents to make requests for proposals to provide human engineering program information. Also see COMMENTS, below.

DOCUMENTATION:
DOD-HDBK-763 (Summarized elsewhere in this Section)

ALTERNATIVE/COMPARABLE APPROACHES:
N/A

STAGE OF DEVELOPMENT:
Available. Approved 31 January 1996. See COMMENTS below.

ORDERING INFORMATION:
See "Ordering Information for DoD Standardization Documents" at the front of this section.

VALIDATION:
Not required until May 1999; however, see COMMENTS, below.

COMMENTS:
MIL-HDBK-46855, 21 January 1996, Department of Defense Handbook: Human Engineering Guidelines for Military Systems, Equipment, and Facilities, replaced MIL-STD-46855, 29 May 1994, Human Engineering Requirements for Military Systems, Equipment, and Facilities. MIL-HDBK-46855 consists of MIL-STD-46855 with a new cover sheet. The content of MIL-HDBK-46855 is being revised and combined with DOD-HDBK-763. The consolidated handbook, MIL-HDBK-46855A, is expected to appear in coordination draft form during the Summer of 1998. The content of MIL-HDBK-46855 is expected to appear in the revision as Section 4, Program Tasks, and as appendices. Upon approval of

MIL-HDBK-46855A, MIL-HDBK-46855 will be canceled, probably in late 1998 or early 1999.

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OVERALL CATEGORY: Standardization Document
STATUS: Available

TITLE: MIL-HDBK-759C, Department of Defense Handbook for Human Engineering Design Guidelines

SPONSOR: Army Aviation and Missile Command
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EMAIL: gprogers@redstone.army.mil
RECORD NO.: HSI00126

GENERAL OVERVIEW:
This handbook provides basic guidelines and data on human engineering design for military systems, equipment, and facilities, and was designed to supplement MIL-STD-1472 (see entry for MIL-STD-1472E). To cue the MIL-STD-1472E user to such supplementary information, this handbook has been formatted to follow the same paragraph numbering, down to the third indenture level, as in MIL-STD-1472E, e.g. paragraph 5.4.5 of both MIL-STD-1472E and MIL-HDBK-759C deal with miniature controls. Some paragraphs, necessarily, do not contain any information, but are reserved to accommodate new information that may become available. Additional paragraphs are added to accommodate information that does not appropriately fit elsewhere. (364 pp)

APPROPRIATE USES:
The handbook is intended to provide human engineering guidelines, preferred practices, and reference data for design of military materiel, both in-house and contracted, to facilitate achieving objectives stated in DoD and Service human engineering policy documents. The handbook also serves to provide expanded, supplementary, and relevant human engineering information that may be too detailed, lengthy, or service-oriented for inclusion in standards, such as MIL-STD-1472. MIL-HDBK-759C is intended for guidance only, not for citation as a contractual requirement. If it is cited contractually, the contractor is not obligated to comply with its provisions.

USES OF OUTPUT:
Provides human engineering guidelines for direct application to design.

DOCUMENTATION:
N/A

ALTERNATIVE/COMPARABLE APPROACHES:
Numerous handbooks, guidelines, and texts are available for application to general design problems. An example of a handbook focused on military systems, equipment, and facilities is the Human Engineering Guide to Equipment Design, H.P. Van Cott and R.G. Kinkade, eds., Wiley, 605 Third Ave., New York, NY 10158, 1972, (Library of Congress Catalog Card No. 72600054).

STAGE OF DEVELOPMENT:
This is a mature handbook. Revision C, approved 31 July 1995 (including Change Notices 1 and 2, approved 28 Feb. 1997 and 31 Mar. 1998, respectively), is the current edition. See COMMENTS below.

ORDERING INFORMATION:
See "ordering Information for DoD Standardization Documents" at the front of this section.

VALIDATION:

Not required until July 2000.

COMMENTS:
Change Notice 1, approved 28 Feb. 1997, was issued exclusively to move anthropometric tables and figures from MIL-STD-1472 to MIL-HDBK-759C. Change Notice 2, approved 31 Mar. 1998, was issued to incorporate and update Table XXVI, Typical Fighting and Existence Loads (Temperate Zone), that was removed from MIL-STD-1472E.

A change notice or revision may be initiated in late 1998 to incorporate applicable material from the Air Force Design Handbook DH 1-3, Human Factors Engineering, that has been inactive for several years.

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OVERALL CATEGORY: Standardization Document
STATUS: Available

TITLE: MIL-HDBK-767, Design Guidance for Interior Noise Reduction in Light-Armored Tracked Vehicles

SPONSOR: US Army Tank-Automotive Command
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RECORD NO.: HSI00128

GENERAL OVERVIEW:
This handbook gives proven guidelines for designing quiet tracked vehicles and reducing interior noise by redesigning vehicle components. The guidelines primarily focus on track and suspension components; additional guidelines are provided for designing a quiet hull and engine enclosure. (86 pp)

APPROPRIATE USES:
The handbook provides design guidance for interior noise reduction of light-armored tracked vehicles weighing less than 30 tons. These guidelines may be applicable for heavier vehicles but have been validated only for weights less than 30 tons. The guidelines are suitable for new vehicle designs, as well as redesign of existing vehicles. The intended audience includes: 1) designers of combat vehicles who are seeking guidance in designing inherently quieter tracked vehicles; 2) vehicle project and product managers who are seeking an overview of the importance of interior noise reduction and how to achieve it; and 3) military officers who are part of the procurement or development community, and who are seeking tradeoff information on the difficulty, expense, impact, and advantages of designing quieter tracked vehicles. DOD-HDBK-767 is intended for guidance only, not for citation as a contractual requirement. If it is cited contractually, the contractor is not obligated to comply with its provisions.

DOCUMENTATION:
N/A

ALTERNATIVE/COMPARABLE APPROACHES:
N/A

STAGE OF DEVELOPMENT:
Approved and available.

ORDERING INFORMATION
See "Ordering Information for DoD Standardization Documents" at the front of this section.

VALIDATION:
Not required until September 1998.

COMMENTS:
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OVERALL CATEGORY: Standardization Document
STATUS: Available

TITLE: MIL-STD-1472E, Department of Defense Design Criteria Standard: Human Engineering

SPONSOR: Army Aviation and Missile Command
POINT OF CONTACT: Ms Glenda P Rogers / 205-955-6125, DSN: 645-6125
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RECORD NO.: HSI00135

GENERAL OVERVIEW:
Establishes general human engineering criteria for design and development of military systems, equipment, and facilities to 1) achieve required performance by operator, control, and maintenance personnel, 2) minimize skill and personnel requirements and training time, 3) achieve required reliability of personnel-equipment/software combinations, and 4) foster design standardization within and among systems. Is probably the best known human engineering design standard in the U.S. MIL-STD-1472E contains brief, general requirements for standardization, function allocation, human engineering design, fail-safe design, interaction, safety, ruggedness, design for NBC survivability, and design for electromagnetic pulse (EMP) hardening. It also contains extensive, detailed requirements for control/display integration, visual displays, audio displays, controls, labeling, workspace design, design for maintainer, design of equipment for remote handling, small systems and equipment, operational and maintenance ground/shipboard vehicles, hazards and safety, aerospace vehicle compartments, user-computer interface, and visual display terminals. (198 pp)

APPROPRIATE USES:
Used to contractually specify human engineering design criteria for detailed design phases such as engineering and manufacturing development. For earlier development, such as demonstration and validation, MIL-STD-1472E is used as a guide. A waiver is required prior to contractual citation as a requirement.

MIL-STD-1472E is essentially self-tailored, since criteria are in effect only to the degree that they apply to hardware or software being designed. Nothing in the standard limits the selection of hardware, materials, or process to the specific items therein. It is not intended to be a criterion for limiting use of materiel already in the field in areas such as lift repetition or temperature exposure time. Finally, when manufacturing tolerances are not perceptible to the user, MIL-STD-1472 does not prevent the use of components whose dimensions are within a normal manufacturing upper or lower limit tolerance of the dimensions specified. (While MIL-STD-1472 was developed for use as a contractually invoked design standard, some individuals and organizations have used it as a handbook. Others have used it as a text.)

DOCUMENTATION:
N/A

ALTERNATIVE/COMPARABLE APPROACHES:
Similar general human engineering design criteria standards are used or are available for applications outside the military product arena. In the government sector, NASA-STD-3000, Man-System Integration Standards (cited elsewhere) and DOE-STAND HFAC 1, Volume 1, General Criteria, are good examples; in the commercial sector, AAMI HE-48, Human Factors Engineering Guidelines and Preferred Practices for the Design of Medical Devices, is a

good example. Several software packages have MIL-STD-1472 embedded, the example being Computer-Aided Systems Human Engineering (CASHE), described elsewhere herein.

The content of MIL-STD-1472 has also been adopted by a number of software packages (see Integrated Design/Engineering (IDEA) under Section 3, and Computer-Aided Human Engineering (CASHE) under Section 6).

STAGE OF DEVELOPMENT:
Approved 31 October 1996. Change Notice 1, approved 31 Mar. 1998, was issued to delete Table XXVI, Typical Gighting and Existence Loads (Temperate Zone).

ORDERING INFORMATION:
See "Ordering Information for DoD Standardization Documents" at the front of this section.

Drafts are not available from the DoDSSP, but may be available from the listed preparing activity's (sponsor's) POC.

VALIDATION:
Not required until 2001.

COMMENTS:
As a result of implementing standardization reform, MIL-STD-1472D, "Human Engineering Design Criteria for Military Systems, Equipment, and Facilities," was revised as MIL-STD-1472E, "Department of Defense Design Criteria Standard: Human Engineering." While the technical integrity of the standard was maintained, the page count was reduced from 423 to 206, applicable documents were trimmed from 81 to 25 (almost half of which are non-government standards), all non-DoDISS document citations were removed, and over two dozen out-of-scope paragraphs were deleted. Moreover, over 600 changes were made to simplify and clarify, changing many "shalls" to "shoulds", and deleting handbook data, out-of-scope provisions, superfluous index material, tasking and "how to" provisions, and ambiguities and redundancies. Some tasking or design requirements were changed to performance provisions where possible.

A technical revision of MIL-STD-1472E is expected to appear in coordination draft form (PROPOSED MIL-STD-1472F) in late 1998 or early 1999.

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OVERALL CATEGORY: Standardization Document
STATUS: Available

TITLE: MIL-STD-1474D, Department of Defense Design Criteria Standard, Noise Limits

SPONSOR: Army Aviation and Missile Command
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RECORD NO.: HSI00116

GENERAL OVERVIEW:
MIL-STD-1474D is a materiel design standard that provides specific noise limits and related requirements to equipment designers and manufacturers. These limits, which must not be exceeded if the materiel is to be acceptable, are intended to cover typical operational conditions. The limits evolved from considerations of hearing damage-risk, speech intelligibility, aural detection, state-of-the-art noise reduction, and government legislation. The maximum limits in the standard are more stringent than Occupational Safety and Health Administration (OSHA) standards (29 CFR 1910.95), and are applied to military materiel in lieu of OSHA standards. MIL-STD-1474D is a Department of Defense Design Criteria Standard in sectional format, structured as general requirements and individual requirements contained in the following seven sections: 1) steady-state noise, personnel-occupied areas; 2) aural nondetectability; 3) community annoyance; 4) impulse noise, personnel-occupied areas; 5) shipboard equipment noise; 6) fixed-wing aircraft noise; and 7) rotary-wing aircraft noise. (Appx 100 pp)

MIL-STD-1474D is also the source document for the following Data Item Descriptions (DID), also approved 12 Feb. 1997:

Noise Measurement Report, DI-HFAC-80938B
Equipment Airborne Sound Measurement Plan, DI-HFAC-80270A
Sound Test Failure Notification and Recommendation Report, DI-HFAC-80271A
Equipment Airborne Sound Measurements Test Report, DI-HFAC-80272A

DI-HFAC-80938B applies to Sections 1-4 (see above). The remainder apply to Section 5.

APPROPRIATE USES:
The standard applies to the acquisition and product improvement of all designed or purchased systems, subsystems, equipment, and facilities that emit acoustical noise. It is intended to address noise levels emitted during the full range of typical military conditions. The standard provides criteria for designing materiel having noise levels that: 1) minimize noise-induced hearing loss; 2) permit acceptable speech communication in a noisy environment; 3) minimize aural detection by an enemy; 4) minimize community annoyance; and 5) provide acceptable habitability of personnel quarters. A waiver is required prior to contractual citation as a requirement.

DOCUMENTATION:
N/A

ALTERNATIVE/COMPARABLE APPROACHES:
None practical. Complying with MIL-STD-1474 is equivalent to complying with the design imperatives of applicable legislation (OSHA for maximum limits; EPA for community annoyance), regulations (DA PAM 40-501, Hearing Conservation, OPNAVINST 5100.23B, Navy Occupational Safety and Health

(NAVOSH) Program Manual, and OPNAVINST 5100.19B, NAVOSH Program Manual for Forces Afloat, and AFR 161-35, Hazardous Noise Exposure (changed in 1995 to AFOSHSTD 48-19, Hazardous Noise Program), and standards (MIL-STD-1472 for communication criteria). Using these source documents for direct application to design and testing would be a costly, inefficient approach, since their maximum limits are not directed at design, but at hearing conservation measures, and would have to be expanded and supplemented for design application. MIL-STD-1474 already accomplishes that end.

STAGE OF DEVELOPMENT:
A current document. Approved 12 Feb. 1997. Change Notice 1, approved 29 Aug. 1997, was issued to correct four paragraph citation errors.

ORDERING INFORMATION:
See "Ordering Information for DoD Standardization Documents" at the front of this Section.

VALIDATION:
Not required until 2002.

COMMENTS:
MIL-STD-1474D was prepared, as directed at the 19 Apr. 95 meeting of the Defense Standards Improvement Council, to consolidate the following noise standards into a single document: (1) MIL-STD-740-1, Airborne Sound Measurements and Acceptance Criteria of Shipboard Equipment; (2) MIL-STD-1294A, Acoustical Noise Limits in Helicopters; (3) MIL-STD-1474C, Noise Limits for Military Materiel; and (4) MIL-STD-1789A, Sound Pressure Levels in Aircraft. Since MIL-STD-1474D was approved, MIL-STD-740-1 and MIL-STD-1789A are being canceled, MIL-STD-1294A has already been canceled, and MIL-STD-1474C has been superceded by MIL-STD-1474D.

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OVERALL CATEGORY: Standardization Document
STATUS: Available

TITLE: MIL-STD-1477C, Interface Standard: Symbols for Army Systems Displays

SPONSOR: Army Aviation and Missile Command
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RECORD NO.: HSI00118

GENERAL OVERVIEW:
This standard prescribes the physical characteristics of symbols and associated alphanumeric information for ground and air tracks, units/installations, control measures, and equipment for U.S. Army Combined Arms system displays which are generated by electronic, optic or infrared technology, and which present information in real time or near-real time. (100 pp)

APPROPRIATE USES:
The standard applies to the design of all U.S. Army Combined Arms system displays, and is tailored as required to meet individual system requirements. These systems include air defense, aviation, armor, infantry, fire support, intelligence and logistics systems. The symbols presented are intended for application to high-quality, calligraphically written, cathode-ray tube displays. The standard may be applied to other, flat-panel type displays if the provisions are modified to ensure that image quality provides legible symbols, modifiers, and alphanumerics. The symbology specified in the standard is not intended to be applied retroactively to existing system; however, any system product improvement program may implement the requirements of the standard.

DOCUMENTATION:
N/A

ALTERNATIVE/COMPARABLE APPROACHES:
For some applications, administrative-type documents, such as FM 101-5-1, Operational Terms and Symbols, could be consulted; however, MIL-STD-1477C is more efficient to use, since it consolidates symbol requirements from several sources and is quite self-contained. A standardization document alternative is MIL-STD-2525, Common Warfighting Symbology, Version 1, 30 Sep 94; however, MIL-STD-2525 is in the Information Standards and Technology Standardization Area, rather than the Human Factors Standardization Area. This suggests that symbol selection may have involved other than human performance and usage bases. The symbols of MIL-STD-2525 were reportedly drawn from STANAGs 2019 (land symbols) and 4420 (maintainer). It is not clear if MIL-STD-1477 was used as a source. MIL-STD-2525 was reportedly developed by the Symbology Standards Management Committee, chaired by DISA, with representatives from the Services and agencies.

STAGE OF DEVELOPMENT:
Available. Approved 30 Sep. 1996.

ORDERING INFORMATION:
See "Ordering Information for Standardization Documents" at the front of this section.

VALIDATION:
Not required until September 2001.

COMMENTS:

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OVERALL CATEGORY: Standardization Document
STATUS: Available

TITLE: MIL-STD-1787B, Department of Defense Interface Standard: Aircraft Display Symbology

SPONSOR: Aeronautical Systems Center
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RECORD NO.: HSI00134

GENERAL OVERVIEW:
Describes symbols, symbol formats, and information content for electro-optical displays that provide aircrew members with information for take-off, navigation, terrain following/terrain avoidance, weapon delivery, and landing. It describes symbol geometry, font, recommended dimensions, and mechanizations. The standard also defines the Symbology requirements for primary flight reference, and describes some fundamental relationships between symbol motion and aircraft system states. The standard does not describe symbols for electronic warfare displays which are normally classified in meaning. It does not describe qualities (other than those mentioned above) that affect legibility, such as resolution, brightness, uniformity, contrast, flicker, noise, minimum line movement, color, etc. The document is structured as a main section and an appendix. The main section is organized as scope, applicable documents, definitions, requirements, verifications, and notes; however, some of the values and text have been left blank for the user to complete based on system requirements and on guidance in an Appendix. The Appendix is organized the same as the main section, but contains rationale, guidance, and lessons learned for the requirements and the verifications. (146 pp)

APPROPRIATE USES:
This standard is used contractually only after all tailoring decisions have been made and incorporated into the wording. In tailoring each requirement and verification provision in the basic standard, the guidance in the appendix should be considered. The requirement for a standard primary flight reference can be incorporated into a contract by requiring primary flight reference displays and Symbology as defined in the first paragraph of the requirements section. MIL-STD-1787B is approved for use by the Aeronautical Systems Center, Department of the Air Force, and is available for use by all Departments and Agencies of the Department of Defense.

DOCUMENTATION:
User's guide appears as the appendix of the document.

ALTERNATIVE/COMPARABLE APPROACHES:
Unknown.

STAGE OF DEVELOPMENT:
Available. Approved 5 April 1996.

ORDERING INFORMATION:
See "Odering Information for Standardization Documents" at the front of this section.

VALIDATION:
Not required until April 2001.

COMMENTS:

MIL-STD-1787B, 5 April 1996, Department of Defense Interface Standard: Aircraft Display Symbology, replaced MIL-STD-1787A, 31 July 1987, Aircraft Display Symbology.

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OVERALL CATEGORY: Standardization Document
STATUS: Available

TITLE: MIL-STD-1801, User/Computer Interface, 29 May 1987

SPONSOR: Aeronautical Systems Center
POINT OF CONTACT: Ms Susan Kaney Breslin / 937-255-6281, DSN: 785-6281
RECORD NO.: HSI00074

GENERAL OVERVIEW:
This Mil-Prime military standard is used to establish in Air Force contracts the proper requirements and verifications concerning the interface between computers and computer operators. Attached to the standard is a user's appendix which gives the rationale, guidance, and lessons learned concerning the requirements and verifications in the standard.

APPROPRIATE USES:
MIL-STD-1801 should be tailored as appropriate when writing userby a interface requirements and verifications that, when accompanied with a Statement of Work (SOW), require a contractor to design a system to meet specific performance requirements to satisfy the terms of a contract.

USES OF OUTPUT:
This military standard is used to specify the critical requirements concerning user-computer interfaces for Air Force systems.

DOCUMENTATION:
MIL-STD-1801 is one of many Mil-Prime documents which are intended for use by DoD and DoD contractors responding to Requests for Proposal (RFP) or to working DoD contracts. Mil-Prime documents are a series of specifications and standards (with their associated handbooks) which outline, in generic form, performance requirements for Air Force aeronautical systems and support systems.

ALTERNATIVE/COMPARABLE APPROACHES:
MIL-STD-1472 and other Mil-Prime documents.

STAGE OF DEVELOPMENT:
Basic document published 11 May 87. Revision was deferred, due to manpower constraints.

ORDERING INFORMATION:
The distribution of MIL-STD-1801 is limited to DoD employees and to those on the Defense Logistics Services Center's list of certified DoD Contractors (see "Ordering Information for DoD Standardization Documents" at the front of this section).

VALIDATION:
Validation was due in May, 1992. Document is administratively overage.

COMMENTS:
Aeronautical Systems Center's Mil-Prime Program consists of generic specifications and standards which specify requirements for the development of new systems in terms of performance. They explain, in an appendix attached to each document, the rationale, guidance, and lessons learned associated with those performance requirements.

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OVERALL CATEGORY: Standardization Document
STATUS: Available

TITLE: NASA-STD-3000, Man-Systems Integration Standards (MSIS)

SPONSOR: NASA-Johnson Space Center, MSIS Production Facility
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RECORD NO.: HSI00109

GENERAL OVERVIEW:
These standards provide specific user information to ensure proper integration of the man-system interface requirements with those of other aerospace disciplines. These man-system interface requirements apply to launch, entry, on-orbit, and extraterrestrial space environments. This document is intended for use by design engineers, systems engineers, maintainability engineers, operations analysts, human factors specialists, and others engaged in the definition and development of manned space projects or programs.

Concise design considerations, design requirements and design examples are provided. Requirements specified are applicable to all U.S. manned spaceflight programs.

This document replaces earlier NASA field center human engineering standards documents (e.g., MSFC-STD-512A, Man/System Requirements for Weightless Environments; JSC-07387B, Crew Station Specifications). The MSIS also incorporates human engineering standards and guidelines from many other NASA, military, and commercial human engineering standards applicable to space environments. These include: MSFC-STD-512A, Man/System Requirements for Weightless Environments; JSC-07387B, Crew Station Specifications; Boff and Lincoln's 1988 Engineering Data Compendium, addressing human perception and performance; Woodson's 1981 Human Factors Design Handbook; MIL-STD 1472, Human Engineering Design Criteria for Military Systems; and MIL-HDBK-759, Human Factors Engineering Design for Army Material.

Chapters in Volume I, the basic, "generic" document, include: Anthropometry and Biomechanics; Human Performance Capabilities; Natural and Induced Environments; Crew Safety; Health Management; Architecture; Workstations; Activity Centers; Hardware and Equipment; Design for Maintainability; Facility management; and Extravehicular Activity.

In addition to the basic document, additional volumes of the MSIS are created and maintained which specifically address the human factors and crew interface needs for that program (such as Volume IV for the now-defunct Space Station Freedom Program). As specialized volumes of this type are updated and revised, the information gathered for them is also evaluated for possible inclusion in the basic MSIS volume.

To date, there are three volumes planned, with four already published and released: Vol. I, Man-Systems Integration Standards, first published in 1987 and last updated as Rev. B in June, 1995; Vol. II, Man-Systems Integration Standards - Appendices, first published in 1987 and last updated in 1995, at the same time as, and to the same revision letter as Vol. I; Vol. III, Man-Systems Integration Standards - Design Handbook, not yet published in August, 1994 (the data in this volume coincides with Rev. A, of Vol. I); Vol. IV, Space Station Freedom Man-Systems Integration Standards, a subset of Vol. I, published in 1987; Vol. V, STS Man-Tended Payload Man-Systems Integration Standards, a subset of Vol. I, never published; and Vol. VI,

Assured Crew Return Vehicle Man-Systems Integration Standards, published in 1992. Volumes IV and VI no longer have applicability to any existing program, and are no longer maintained. There currently exists a document within the International Space Station (ISS) program documentation control system, International Space Station Flight Crew Integration Standard SSP-50005, which is a subset of Vol. I, and is totally maintained and distributed by the ISS Program Office at JSC. Hard copies of ISS program documents may be obtained by calling the Space Station Library at JSC at 281-244-7066.

APPROPRIATE USES:
The MSIS includes comprehensive information on anthropometry and biomechanics, human performance characteristics, and natural and induced environments, to give designers sufficient insight into the effects which these additional factors will exert on the human interfacing with the system.

All of the human interface requirements developed for application to space-related systems are also directly applicable to terrestrial systems. Not all of the MSIS requirements would be applicable to any individual earth-based system; but taken as a whole, most of the requirements would find use in a terrestrial system somewhere. The only specific exceptions would be those interfacing with the micro-gravity (zero-gravity) environment. Even the requirements for many of the Extravehicular Activity systems will be applicable to the development of equipment for the handling of hazardous materials or for use in hazardous environments. It is appropriate to note that most of the requirements included in the MSIS were, indeed, derived from data extracted from testing in the terrestrial environment, with appropriate interpretation thereof.

Systems which could potentially benefit from the MSIS documents (as the basic document currently exists, or as customized additional volumes developed specific to the application) are many and varied. Examples are: automobiles, recreational vehicles, pocket radios, video cassette recorders, home appliances, commercial electronics hardware, furniture products, home interiors and places of business. Using a document such as the MSIS, the design process could be made considerably more efficient, consistent, and cost-effective in its output, while resulting in much more user-friendly end-products.

EQUIPMENT REQUIRED:
None for the end user; hard-copy document.

OUTPUT:
Hard-copy documents.

USES OF OUTPUT:
Human factors analyses.

DOCUMENTATION:
Man-Systems Integration Standards (MSIS), Volumes I, II, and III.

The MSIS database, which includes sources and history of all data and changes in the volumes, and contact information about recipients of the standards.

ALTERNATIVE/COMPARABLE APPROACHES:
Various other standards and guidelines, many of which have been incorporated into the MSIS.

STAGE OF DEVELOPMENT:
Volumes I, II, and III are complete and undergoing revisions as needed and funding allows. Volumes III and V are under development. Future plans include placing the MSIS database on the Internet. A multi-media, online version of the standard is nearing completion, and should be up and fully functional by early Spring of '98. This electronic version, contained within a specialized software program known as PHIDAS, will allow visitors to the MSIS Web site to browse parts or all of Volumes I and II. Visitors will also be able to access background and source information on all of the data contained in the standards, and the various video-clips which have been gathered to illustrate the information contained within the documents. Parts or all of this information can be downloaded by any Web site visitor. The URL for the MSIS Web site is:
<http://www-sa.jsc.nasa.gov/FCSD/CrewStationBranch/Msis/MSIS_home.html>
The E-mail address for the MSIS is: msis@spmail.jsc.nasa.gov.

COMMENTS:
MSIS volumes, either generic or specific, can be developed to address the concerns of specific environments, such as: ocean surface, subsea, mountainous, desert, subterranean, urban interior, etc. Systems which could potentially benefit from the custom development (through the creation of additional specific volumes) of MSIS documents are many and varied.

Procedures are in place to enable any professional or industry organization, company, or individual to come to NASA-JSC and contract for a version of the MSIS, produced to fulfill their specific needs. These additional volumes would be created utilizing the equipment and processes developed for the creation of the program-unique volumes already in existence.

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